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The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LV
NO. 1434

SATURDAY, DECEMBER 21, 1946
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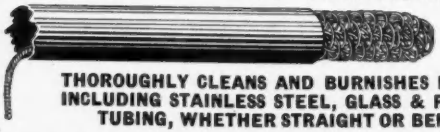

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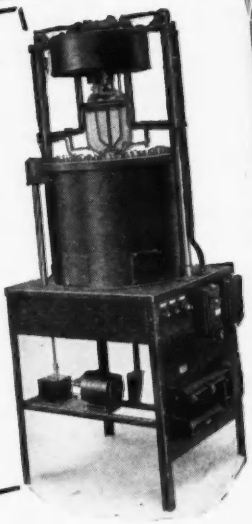

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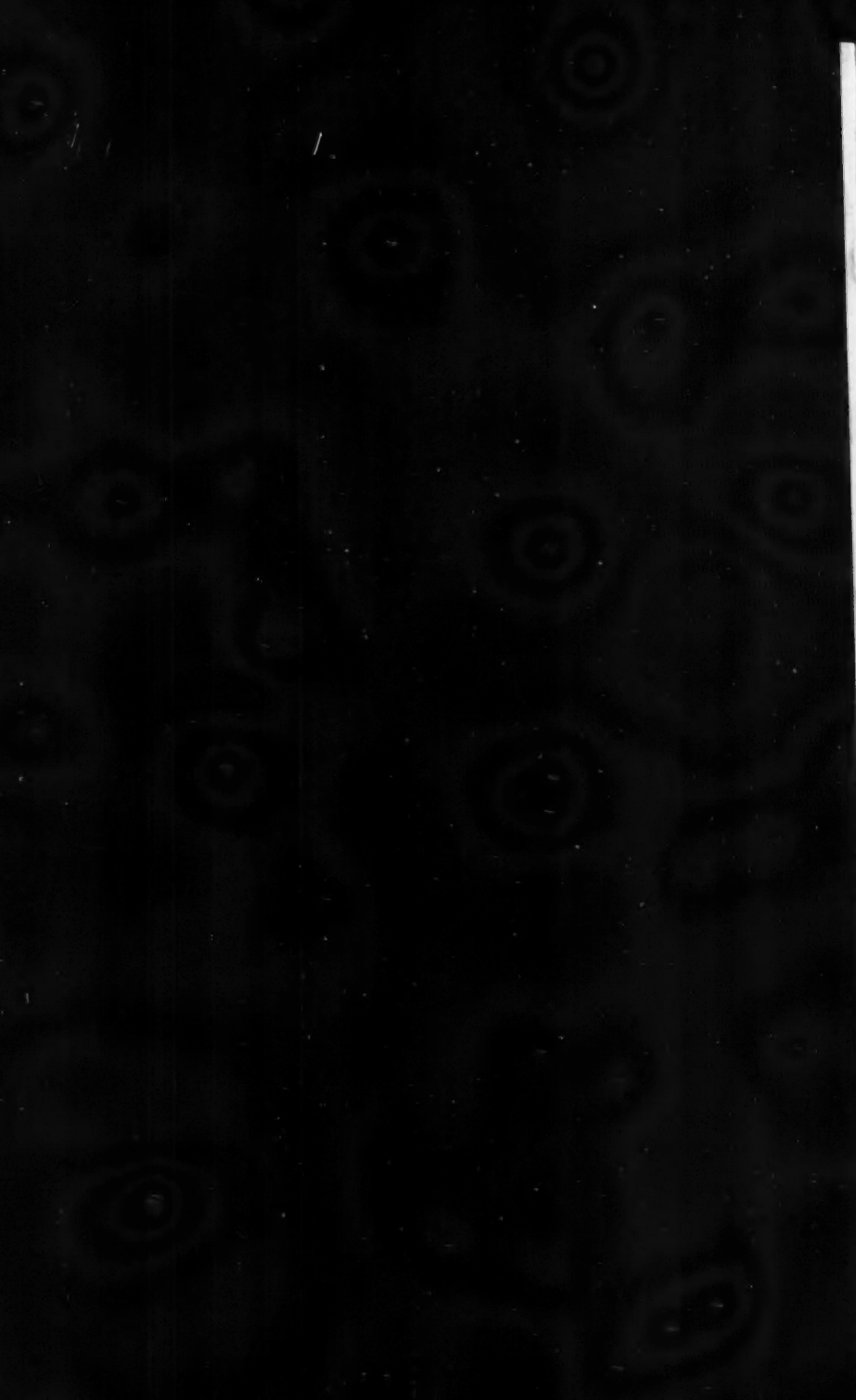

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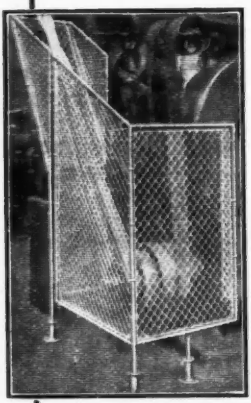

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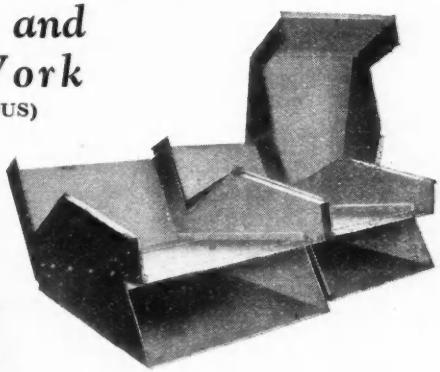

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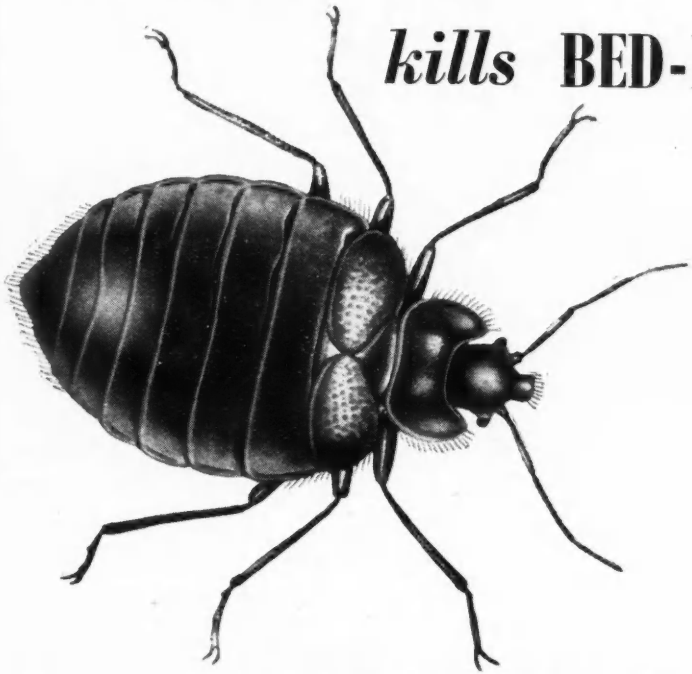

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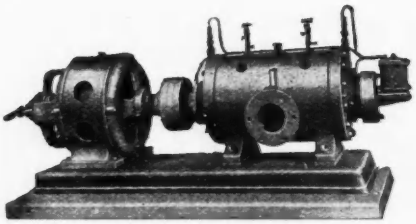

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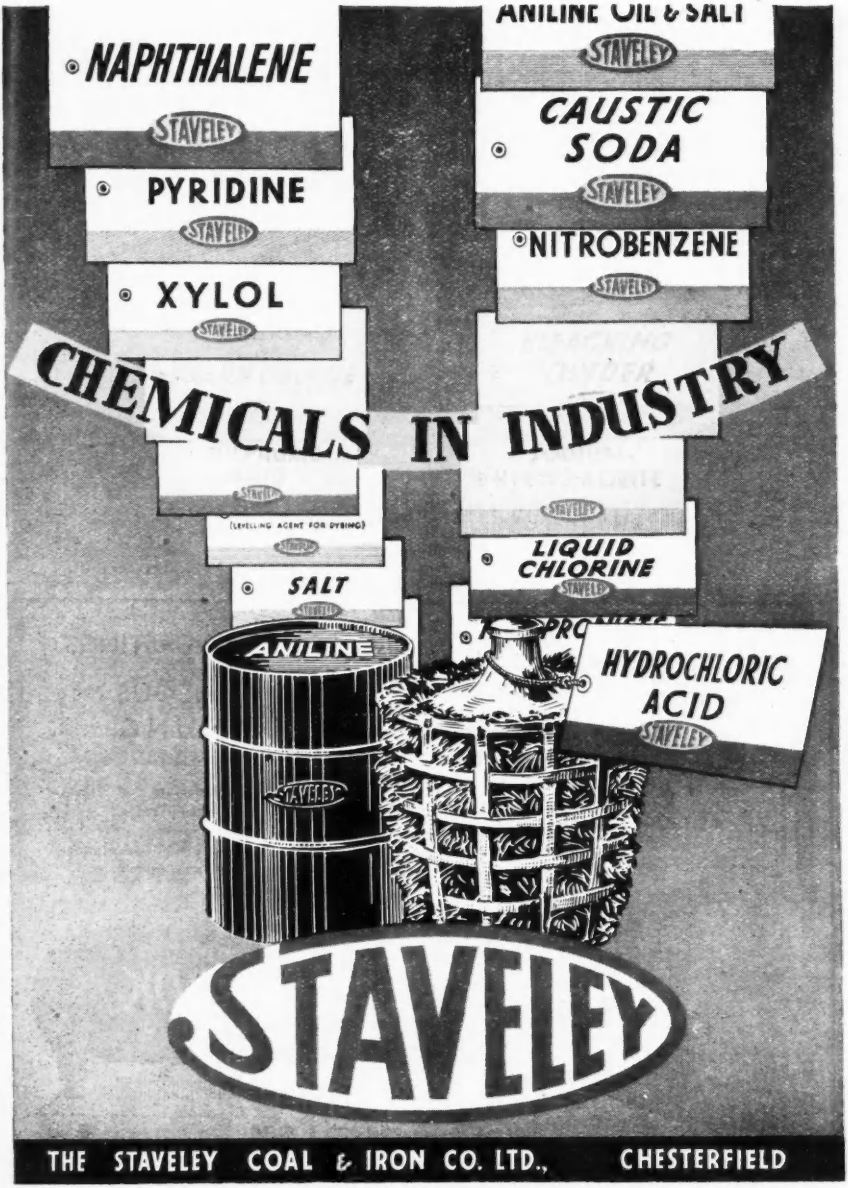
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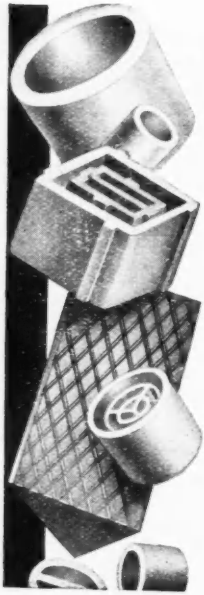

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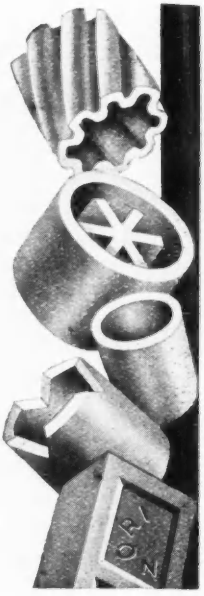

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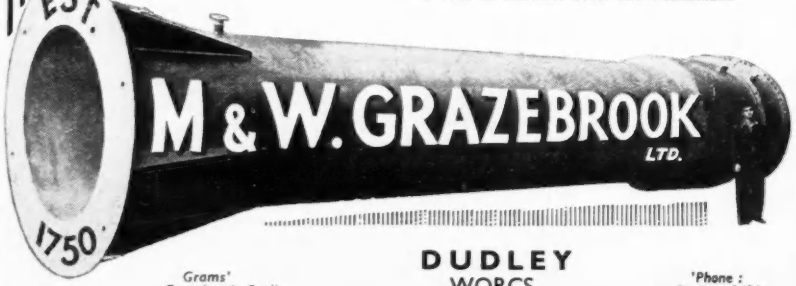

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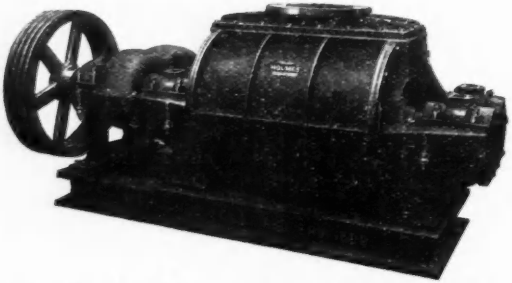

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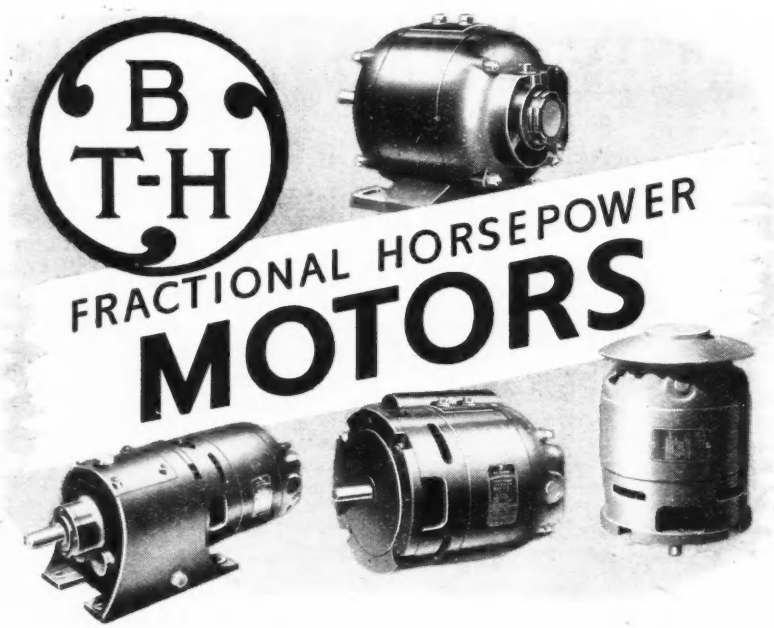

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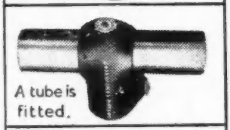

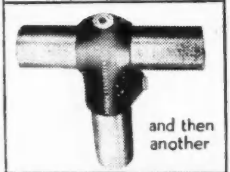

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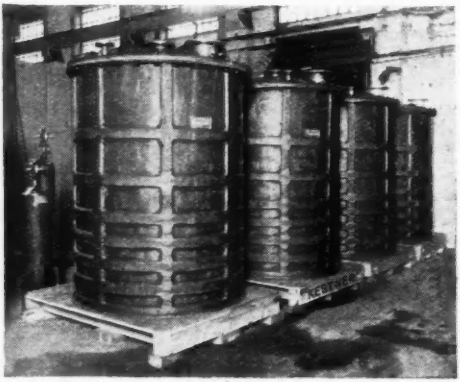

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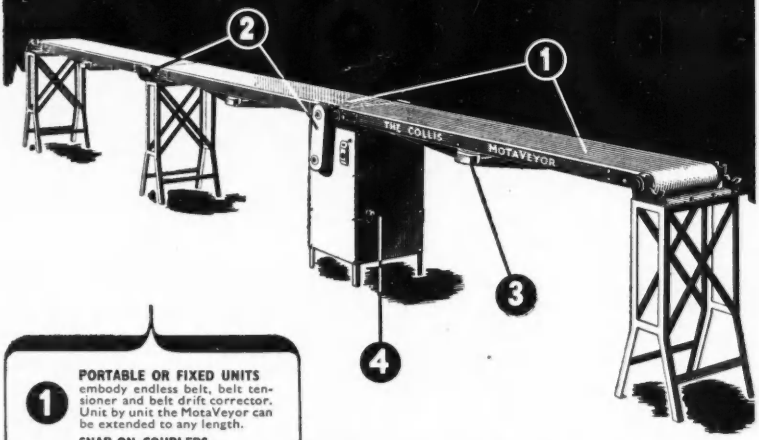

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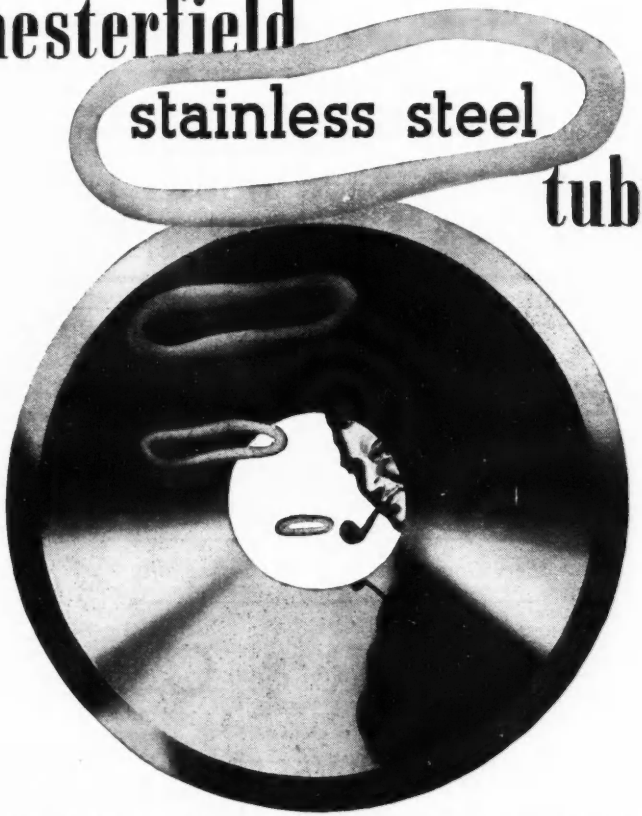

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Coke Ovens Under Nationalisation

WITH the nationalisation of the coal mines has come the nationalisation of the coke ovens owned by collieries; thus a part of the chemical industry has been nationalised. The first step along the path of socialisation has been taken, and he would be a bold man who would predict how far that path will lead us.

The direction in which things are moving was disclosed by Mr. Shinwell and Lord Hyndley at the annual luncheon of the Coke Oven Managers' Association in October. The coking industry has never taken its full place as a part of the chemical industry of the country because it has been under the ownership of those whose interests and responsibilities lie primarily in the field of coal mining and not to a great extent in that of chemicals. There are men on most colliery boards who have wide interests, not infrequently embracing the chemical industry, but they cannot for the most part describe themselves as chemists or chemical engineers. There have been outstanding exceptions to the generalisation we are making, but generally it is true to say that coke ovens have been regarded as means for making the silken purse of metallurgical coke from the sow's ear of whatever coal the colliery could not dispose of to better advantage. The first major concern of the newly-nationalised coke-oven managers, therefore, was that in the new dispensation they should be separated from the colliery. That objective has been secured. Mr. Shinwell had no hesitation in declaring that the collieries would require modernisation and that colliery managers would have far too much to do to look after their own work to meddle with by-product coking. We applaud that decision. The operation of coal carbonisation is a part of the chemical industry and produces products that are used as raw materials by other branches of that industry. Even blast-furnace coke is in effect a chemical since it is used partly as a reducing agent in the blast furnace.

The second concern of the Coke Oven Managers' Association has been that the by-product coke-oven process shall be regarded as kin to the gas industry and to the chemical industry. The new President, Mr. G. A. Phillipson, has suggested that the coke and gas produced in "off-season" working should be converted into chemical products. He said in his presidential address, "During the summer months gas surplus to domestic requirements could be delivered to synthesis plant and from this supply, augmented by coke, the synthesis process operated; concur-

NOTICE TO READERS

Owing to greatly increased printing and publishing costs, the annual subscription to THE CHEMICAL AGE will be raised to 26/- per annum, as from January 1, 1947. This is the first increase since THE CHEMICAL AGE was founded over 26 years ago.

rently, during this period surplus coke could be stored. When the winter demand re-appears and the surplus gas is no longer available, then the synthesis plant will be turned over to operate on stock coke. Such a programme might take some years to bring to fruition, but benefits will be derived as each section of the development programme is completed." Mr. Phillipson has put forward a bold scheme which would link the coke ovens more directly with the chemical industry. He suggests that the coke ovens be directly linked with the gas industry and that gas grids be built to enable pithead carbonisation plants and gasworks to co-operate to bring gas to everyone. Through these gas grids, coal gas would be supplied to chemical works for the production of chemicals from the constituents of the gas. Those works could be for the production of ammonia, methanol and similar products now being produced already at one works in this country and many works on the Continent; or they could be Fischer-Tropsch synthesis plants. The reference to coke makes us believe that he had the Fischer-Tropsch process in mind. Mr. Phillipson was connected with the Fischer-Tropsch process in its earlier commercial developments, and is no doubt well informed as to its potentialities, but the findings of the BIOS team which were discussed in these columns last week suggest that the time is not yet ripe for commercial developments on these lines.

The need for the future is for research work of a commercialised character in the direction of expanding the coking industry. The iron and steel industry has sponsored most of the organised research work undertaken by coke producers; that is natural since that industry is dependent upon the quality of coke for the efficient production of the iron it manufactures. It may be ungracious to suggest that it has been a major disaster for by-product coking and for the chemical side of that industry that the research work should have been concentrated on coke as a reagent for the blast furnace. The chemical development of by-product coking has been sadly neglected. This is a direction in which not even the builders of coke ovens, usually foremost in research, have shown any active interest. Mr. Phillipson sees that clearly for he says: "The coal processing and carbonising industry should be placed under a National Carbonising Board, on lines more or less similar to the German Ruhr system, where the preparation of coal and all chemical processing is under the direction of expert technicians trained in the industry."

There is to-day a shortage of trained men for almost every industry and the coking industry is not immune from this difficulty. The demand in Mr. Phillipson's words is that there should be more training facilities: "At the moment efforts in this direction are not sufficiently co-ordinated, and a concentration on agreed courses could be made, particularly specialising in the training of physicists and organic chemists which are the two most important branches necessary to develop to the utmost the scientific treatment of coal." Once more, the emphasis is placed upon scientific treatment and the linkage of coking with other chemical industries.

These, then, are the aspirations of those who constitute the works management of coking plants. Where do they lead? The intention of the National Coal Board appears to be to place the coking industry under a centralised Directorate acting under the Board. The Coal Board has Sir Charles Ellis as its scientific director, and as we understand Mr. Shinwell's remarks, Sir Charles is expected to develop the chemical side of coal utilisation. We imagine that the coke ovens will at a later stage be removed from the jurisdiction of the Board and placed with the gas industry under a National Carbonising Board. Certainly the Coal Board should not seek to control the gas industry; we have heard whispers that such is its intention. The great question-mark is what chemical products are needed that can be produced from coal, and in what quantities. These questions lead to the same conclusion as we reached last week, namely, that some expert inquiry is needed to determine the answers to them. We suggest that the A.B.C.M. and the Government departments concerned should set up such an inquiry.

Known as "Good-rite," a rubber-like chemical which is basically polyethylene polysulphide is stated to be in commercial production by the B. F. Goodrich Co., of America, for spraying on trees and plants and sealing them from attack by insects and fungi. On application with normal spraying equipment, a microscopic rubbery web is formed on fruit and trees and it stretches with growth. It is claimed that no taste or odour remains on the fruit if applications are discontinued six weeks before harvest.

NOTES AND COMMENTS

WE extend to our readers the time-honoured and sincere wish of a very Happy Christmas and a Prosperous New Year. At this, the closing of a year of peace, the chemical industry can view with pride the past year's achievements and look with quiet confidence to the coming year. Our industry can congratulate itself on work well done. It is one of the few whose output has gone up by leaps and bounds. Its goods find a ready market overseas. And, if the stability of the labour-management relations is a criterion, we can safely assert that the industry is a happy one. No large-scale labour disputes—or even small ones to our knowledge—have marred relations between workers and employers. Everybody in the industry has a keen interest, as well as a financial stake, in its present prosperity. And that prosperity and friendly relations which were so marked a feature of 1946, will, we hope and think, continue through 1947.

A USEFUL SURVEY

A REPORT on a survey of scientific man-power in the Manchester area gives interesting and valuable information especially to would-be entrants into the chemical industry. The survey was made in an effort to assess the increase to be expected in the number of technically-trained men to be employed by industry in the coming years, compared with the years before the war. It was carried out by means of a questionnaire sent by the Manchester Joint Research Council to a representative cross-section of the industrial firms in the Greater Manchester area. From the answers it would seem that although the number of chemical firms employing graduates has increased only by 21 per cent, the number of graduates employed in the whole chemical industry has increased by 100 per cent; while the total increase in the number of employed graduates in all industries was 80 per cent. The chemical industry appears, therefore, to be absorbing a proportionately greater number of university-trained men than other industries. The firms were also asked if they were in favour of graduates having a period of post-graduate research at the university before recruitment. Over half the chemical firms were in favour of this, compared with an average of 38 per cent in all industries. Among the industries offering openings on the scientific research and development, technical and managerial sides, the chemical industry was high on the list. No less than 56 per cent offered openings to graduates in a scientific capacity (research and development), 83 per cent to graduates in a technical capacity and 70 per cent to graduates in a managerial capacity. These figures will be very heartening to the young men in the universities. They show that not only are there openings in all fields of industry, and especially the chemical industry, but that in over 60 per cent of the firms offering employment to graduates the higher executive posts are open to the scientist who shows himself to be competent and adaptable. Young graduates will also be wise to take note of the marked preference which most firms—especially the larger ones—have for men with research experience and methods. (The smaller firms laid greater stress on technical training for graduate staff.) This survey, the first of its kind, should not only give a lead and encouragement to university men, but should also provide the universities themselves with a foundation for the assessment of the extra calls to be expected from industry for graduates in the future years, and the degree of training called for by the various sections of industry. Manchester is to be congratulated on this pioneer work.

A.B.C.M. DIRECTORY

THE good things of pre-war days are sadly slow in coming back to us. At least one good thing, however, has made its welcome re-appearance and that is a new edition of *British Chemicals and their Manufacturers*, which is the official directory of the Association of British Chemical Manufacturers and a reference book without which no chemist's library is complete. This is the first revised edition since 1939, for during the war years the Association were prohibited by Government regulations from bringing out an up-to-date edition, since, of course, the information it contains concerning British chemical factories

might well have got into enemy hands. The new edition is now able to present up-to-date information regarding the manufacture of all types of chemicals, including heavy, fine and pure. In earlier years the Association brought out a second publication, *Directory of British Fine Chemicals*, but both this and the 1939 edition of *British Chemicals and their Manufacturers* are now superseded. The new edition incorporates the subject matter of both and will thus undoubtedly be of double service to users, for, while its format is smaller than that of the 1939 edition, considerably more information has been compactly embodied in it than in the two original directories. One omission entailed in the restricted size is that of the equivalent names in various foreign languages of the different chemicals listed. Unfortunately, the Association were able to acquire only half the paper which they could usefully have employed. On the grounds that the directory was not published during the war, the paper controllers declined to grant a bigger allocation—typical Government department logic, since it was by Government order that there was no publication during the war. However, there is abundant value in the new edition, despite its restricted size, and we are sure our readers will be prompt to secure a copy, which they can obtain *gratis* if they write to the Association at 166 Piccadilly, London, W.1, indicating their *bona fides*.

THE TRANSPORT BILL

THE Association of British Chemical Manufacturers, the British Iron and Steel Federation, and the Fertilisers Manufacturers' Association are among the influential trade organisations which have joined, albeit indirectly, in the fight against the nationalisation proposals of the Government as contained in the Transport Bill. These organisations are members of the Traders' Dock and Harbour Co-ordinating Committee, which has issued a declaration viewing " with gravest concern " the Governments proposals as they relate to port facilties. This is one of the latest developments in the struggle against the Bill and is indicative of the growing opposition. Earlier, there came a Stock Exchange memorandum to the Government, in which the Council stressed that Stock Exchange quotations cannot form a fair and equitable or a rational basis for compensation. This was followed by a statement from the Association of Investment Trusts and the Investment Protection Committee of the British Insurance Association, demanding an unbiased judicial inquiry. The opposition has been yet further strengthened by the formation of a powerful liaison committee of transport and industry. Organisations represented on the committee will be kept informed of steps it is proposed to take against the nationalisation of transport and the committee will consider the best means of joint action to secure a public inquiry before the Bill becomes law. Mass meetings of railway stockholders have also strongly protested against the Bill. It was in this atmosphere of indignation that the Bill came before the House of Commons for its second reading at the beginning of this week.

MICROBIOLOGY

A POINTER to the increasing interest in microbiology is the announcement that the newly-founded Society for General Microbiology, the president of which is Sir Alexander Fleming, of penicillin fame, is to issue its own journal. With the title of *Journal of General Microbiology*, the first number will appear in January and in the first place will consist of three numbers a year. Its purpose is to publish original research work in the field of general microbiology and to promote the advancement of microbiology by providing means whereby the work in various specialised fields can be gathered together for the benefit of all workers in microbiology. The Society was founded for the study of bacteria, micro-fungi, microscopic algæ, protozoa and viruses in their various biological activities and, more particularly, the fundamental aspects of the study of these forms, including their structure and development, physiology and nutrition, genetics and cytology, systematics, ecology, antibiotic activity and reaction to chemotherapeutic agents. The editorial board of the journal will consist of Dr. B. C. J. G. Knight, and Dr. A. A. Miles, editors, and Dr. G. C. Ainsworth, Professor W. B. Brierley, Dr. T. Gibson, Dr. A. T. R. Mattick, Dr. Kenneth Smith, Dr. A. W. Stableforth, and Dr. D. D. Woods as associate editors. It will be the policy of the editors to publish not only papers having an immediate bearing on general microbiology, but also papers on specialised aspects of the various subjects.

PROGRESS IN HYDROGENATION OF COAL AND TAR*

by KENNETH GORDON, C.B.E., M.C.†

THE Billingham coal hydrogenation plant was designed originally to make 100,000 tons a year of petrol by the hydrogenation of Durham coal. It was decided to complete the vapour-phase section of the plant first, and to start this with creosote oil, so that when the coal-hydrogenation section was ready, operations would not be delayed by difficulties in the subsequent vapour-phase section. This involved the installation of a distillation unit for re-running the creosote oil and additional storage tanks. Before the erection of the plant was completed it was decided that more hydrogen could be made available than had originally been expected, and the manufacture of 42,000 tons a year of petrol from creosote oil was made a permanent addition to the original scheme.

Very soon after the start of plant operations it was apparent that, while creosote could be hydrogenated on the large scale with the efficiency predicted by semi-technical experiments, detailed plant modifications would be necessary for a satisfactory output from coal. Purchases of creosote were therefore increased in 1936 to raise petrol production from this raw material to 75,000 tons a year.

The practical difficulties in the hydrogenation of coal were gradually overcome, and from the end of 1936 to the beginning of the war, coal hydrogenation continued without mechanical trouble. As a measure of the reliability of coal hydrogenation, the longest uninterrupted run obtained on one of the units of the coal hydrogenation plant at Billingham was seven months; the average run in the years 1937 to 1939 was 2¼ months.

Effect of Coal Costs

During this period increases in the price of coal, and consequently in the cost of hydrogen, had an adverse effect on petrol costs, which was most marked in the case of coal hydrogenation. Consequently, despite the establishment of the coal process, creosote continued to be treated in much greater quantities than were anticipated in the 1934 plan. This is shown in Table I, which gives the relative amounts of petrol made from coal and creosote year by year.

The petrol was made to comply with various market requirements and was finished to specifications laid down by the oil marketing companies—Shell Mex and B.P. and the Anglo-American Oil Company—who undertook the distribution of our products. Commercial grade, No. 1 premium—both straight and leaded—and 87 octane number aviation fuel comprised the pre-war production. During the war period, 87 octane number fuel, pool petrol, and base spirit for 100 octane number fuel were made.

TABLE I.

OUTPUT OF PETROL AT BILLINGHAM, 1935 TO 1945.

Year.	Petrol produced from coal. Tons.	Petrol produced from creosote. Tons.
1935	11,000	58,000
1936	35,000	76,000
1937	44,000	74,000
1938	52,000	91,000
1939	28,000	120,000
1940	—	148,000
1941	—	111,000
1942	—	92,000
1943	—	76,000
1944	—	106,000
1945	—	97,000

In 1939 it was decided to rearrange the plant to increase the amount of petrol made from creosote to 180,000 tons a year, with a corresponding reduction in the petrol made from coal to 20,000 tons a year. This gave an overall increase in the output of the plant, and left coal hydrogenation operating on a sufficiently large scale for continued study of the process.

The original plant was built with two coal hydrogenation stalls, one heavy-oil hydrogenation stall, and two vapour-phase hydrogenation stalls. The alterations intended were to modify the plant to give us two combined units for heavy-oil and coal hydrogenation, two units for the first stage of vapour-phase hydrogenation, which we call "saturation," and two for the second stage, which we call "splitting." At the same time additional units were to be installed for the distillation of creosote oil, and of the increased quantity of vapour-phase product which would be made. Owing to the incidence of the war, this is the only part of the scheme completed.

It was also decided early in 1939 to install a plant for the manufacture of iso-octane on a scale of 10,000 tons a year by the dehydrogenation of butane to butenes, followed by polymerisation and hydrogenation. The completion of this plant was also delayed by the war, but it was operated for the first time in October, 1940. This was the first plant installed in the world for this process.

Questions arising from the operation of the plant under wartime conditions had re-

* From a paper presented to the Institute of Fuel in London on December 9.

† Joint Managing Director, Billingham Division, Imperial Chemical Industries.

ceived much study before September, 1939. The hydrogenation of coal under such conditions appeared to be extremely difficult. It was a fundamental part of defence that the pressure should be released from high-pressure plants during air raid periods so that the secondary damage arising from fires and explosions which would be caused by escapes of gas could be avoided. While most high-pressure units can be put out of action in a few minutes, a coal-hydrogenation unit requires a much longer time, since it is necessary, if heavy coke formation is to be avoided, to displace the coal contained in the reaction vessels with oil before the release of pressure. It was therefore decided that coal hydrogenation would be difficult, if not impossible, during the time where there were frequent air raids, and coal hydrogenation was therefore discontinued at the outbreak of war.

Increased Demand

It was not long before the increase in the price of coal meant that a resumption of this part of the process would be quite uneconomic, and the shortage of coal meant that the raw material was not in any case available. There was also an increased demand for hydrogen for ammonia manufacture to give the maximum output of fertilisers for home food production. Coal hydrogenation was not therefore resumed, and there does not appear to be any immediate prospect of its being restarted. Creosote hydrogenation continued throughout. In the early days of the war the only product was 87 octane number aviation fuel. For a period, pool motor spirit was made, but from May, 1942, the sole output of the plant has been 100 octane number aviation fuel components.

From 1943 onwards the Billingham hydrogenation plant was run in conjunction with the oil hydrogenation plant at Heysam, and the Shell Company's iso-octane plant at Stanlow, to produce the maximum possible output of aviation fuel. In 1944 one of the hydrogenation units at Billingham was converted to the manufacture of butyl benzene, to which the name of " Victane " was given, for use as an aviation spirit component. This material was made by the alkylation of benzene with the butylenes obtained from the iso-octane units. Its manufacture was thus to a large extent alternative to the production of iso-octane. This is not the place to give the details of this combined effort in aviation spirit manufacture. The total output was at a rate of 500,000 tons a year; a substantial and a timely contribution to the great quantities required. Billingham provided nearly a quarter of the total.

A plant was installed in 1937 for the recovery of phenol, cresol and xylenols from the hydrogenation product. The crude material from coal hydrogenation is very rich in these minerals, as is indicated in Table II. The recovery of butane, and its sale as bottled gas, have been previously referred to. A propane recovery plant was added in March, 1940, and during the war there have been considerable developments in the use of this product as a replacement for acetylene for metal cutting.

TABLE II.
YIELDS OF PHENOL AND CRESOL FROM COAL.

	Yields from 100 tons a.m.f. coal.*	Per cent by weight of total liquids produced.
	Tons.	
Phenol	1.2	2.2
Cresol	3.5	6.5

* a.m.f. = weight of coal on an ash and moisture free basis.

During the years before the war, many schemes were prepared for other coal hydrogenation plants. In spite of the degree of protection afforded and guaranteed, no sufficiently attractive scheme could be evolved. If any development had taken place it would have been along the same general lines as that at Billingham, except that the methane-steam process would have been relied on to a greater extent for the manufacture of hydrogen, and that a somewhat higher operating pressure would have been employed in place of the Billingham standard of 250 atmospheres.

Aviation Spirit

Very considerable attention was given to the production of aviation spirit, since the base spirit made by hydrogenation has a very high octane number. It was decided that coal hydrogenation would be too expensive as a source of aviation fuel, and in view of the shortage of coal which arose during the war we can regard this decision as fortunate. Creosote derived from coal, and gas oil from petroleum, were the alternative raw materials. Petroleum oil had the advantage that it was available in unlimited quantities, and that its treatment requires only half the quantity of hydrogen needed for creosote oil. Both the capital and running costs of manufacture of aviation spirit from petroleum oil were therefore considerably lower than from creosote, and this factor was held to offset the disadvantages of reliance on imported material, and the somewhat lower quality of the petrol produced.

A safeguard existed in that a plant designed for the hydrogenation of gas oil could without extensive alterations be used for the hydrogenation of creosote oil, although its output would then be reduced to about half, because of the greater quantity of hydrogen needed. As a result of these investigations, Imperial Chemical Industries,

Ltd., the Shell Refining & Marketing Co., and Trinidad Leaseholds, Ltd., acting together as a joint company known as "Trimpell, Ltd.," built and operated for the Air Ministry, later the Ministry of Aircraft Production, a plant at Heysham for the manufacture of 300,000 tons a year of petrol by the hydrogenation of gas oil and 50,000 tons a year of iso-octane made from butane arising from hydrogenation. This plant was completely successful in operation, and its full description must be the subject of another paper.

A very full account of the development of the hydrogenation process in Germany is in preparation by the teams visiting them just before and after the end of the war.*

TABLE III.

CAPACITY OF GERMAN HYDROGENATION PLANTS.

Plant	Main raw materials.	Capacity for production of liquid oil products.	Actual maximum output rate achieved.
		T./yr.	T./yr.
Scholven ...	Bituminous coal	220,000	240,000
Gelsenberg ...	" "	400,000	435,000
Blechhammer	" "	425,000	65,000
Pölitz - Stettin	" " pitch, tar and heavy petroleum residues	700,000	750,000
Welheim ...	Pitch and tar...	130,000	145,000
Lutzkendorf...	Tar and petroleum residues	50,000	12,000
Wesseling ...	Rhine brown coal	200,000	230,000
Leuna ...	Middle German brown coal and brown coal tar	620,000	640,000
Böhlen ...	Brown coal tar	250,000	275,000
Magdeburg ...	" " "	250,000	275,000
Zeitz ...	" " "	250,000	250,000
Brüx ...	" " "	400,000	360,000

From the technical point of view there is only one departure from the process as operated in this country at the outbreak of war. The pressure of the latest coal-hydrogenation units was raised to 700 atmospheres. This pressure was not employed so much to give an increased yield as to avoid the rather complicated catalytic conditions which are necessary for operation at pressures in the range of 200 to 300 atmospheres. These conditions, which were discovered in the laboratories at Billingham, are the use of tin as the catalyst combined with active chlorine in the form of ammonium chloride to give a definitely acid condition during the reaction. This involves the neutralisation of the vapours before condensation takes place, with a suspension of alkali in oil, to avoid the serious corrosion in cooling equipment which would otherwise occur. At higher pressures much the same yields can be obtained with a simple iron catalyst. A combination of acid catalytic conditions with higher pressures is impracticable because it is impossible to avoid corrosive conditions.

The striking thing about the German developments was, not their quality, but their quantity. Table III gives a list of the German hydrogenation plants. Some small coal hydrogenation plants have been built in France and in Japan, but there is no other big-scale development.

The hydrogen required for hydrogenation at Billingham is still made by the method described on a previous occasion. There have as yet been no developments for the manufacture of hydrogen employing bituminous coal directly as the raw material. In Germany there was considerable work on new forms of water-gas generators, but most of this was directed to the employment of low-grade fuels which would not be available for gasification by standard methods.

A combination of coke ovens and water-gas plant is neither very efficient thermally, nor is it inexpensive in operation, because of the intermittent nature of both operations. Table IV gives an indication of the thermal efficiency of the processes for making hydrogen in the form of "catalysed gas" from coal; in this connection thermal efficiency is defined as the ratio of the net heat of combustion of useful products to net heat of combustion of raw materials.

TABLE IV.

(ALL QUANTITIES PER 1000 M³ OF HYDROGEN).

Material	Quantity Kg. or m³.	Net calorific value K.cal./Kg. or m³.	Thermal efficiency of process per cent.	Remarks
Coal	765	7600	85	Includes by-products, surplus gas and breeze.
Coke	550	6900		
Water gas	1100	2380	69	Includes water gas with > 2 per cent. nitrogen purged each cycle. Excludes steam recovery.
Catalysed gas	1550	1570	93	Assumes complete conversion of CO
Overall coke hydrogen ...	—	—	55	

The most striking development in the manufacture of hydrogen has been the so-called "methane-steam" process. Methane —or for that matter any other saturated

* See *Report on the Petroleum and Synthetic Oil Industry in Germany*, submitted to the Minister of Fuel and Power by the Committee on German Oil Production Plants (to be published shortly). There is also a shorter account published in a paper by R. Holroyd read to the Junior Institution of Engineers, Incorporated, in May of this year

TABLE V.

OPERATING CONDITIONS—METHANE-STEAM PLANT.

Gas	Rate m³/hour	Calorific value T. cal./1000 m³	Analysis (per cent.)						
			H_2	CO_2	CO	N_2	H/C's	O_2	H_2O
Hydrocarbon gas	3,150	11,713	46.0	—	—	4.8	48.2	—	—
Reformed gas	17,350	—	74.8	11.3	11.8	1.0	1.3	—	—
Catalysed gas	18,600	2,022	77.1	17.7	3.1	1.0	1.1	—	—
Flue gas	22,200	—	—	12.5	—	66.8	—	4.6	16.1
" H " water gas—Fuel ...	5,800	2,400	52.5	6.3	38.7	1.5	0.4	0.2	—

Material	Usage or make	Temperature point	Temperature °C
HP steam	10.1 te.*/hr.	Inlet interchanger	170
		Exit interchanger	398
LP steam	5.0 te./hr.	Inlet interchanger	110
	m³/hr.	Exit interchanger	385
Hydrocarbon gas	3,150	Exit interchanger	400
Reformed gas + steam	24,700	Exit furnace	680
Reformed gas	17,350	Inlet CO converter	380
Catalysed gas	18,600	Exit CO converter	443
Catalysed gas	18,600	Inlet gas cooling tower	205
Flue gas	22,200	Exit furnace	942
Flue gas	22,200	Exit waste-heat boiler...	431
Flue gas	22,200	Stack	189

$$\text{Thermal efficiency} = \frac{\text{Calorific value catalysed gas made}}{\text{Calorific values H/C gas used and fuel gas used}} \times 100$$

= 73.8 per cent.

* te. = metric tonne of 2,204 lb.

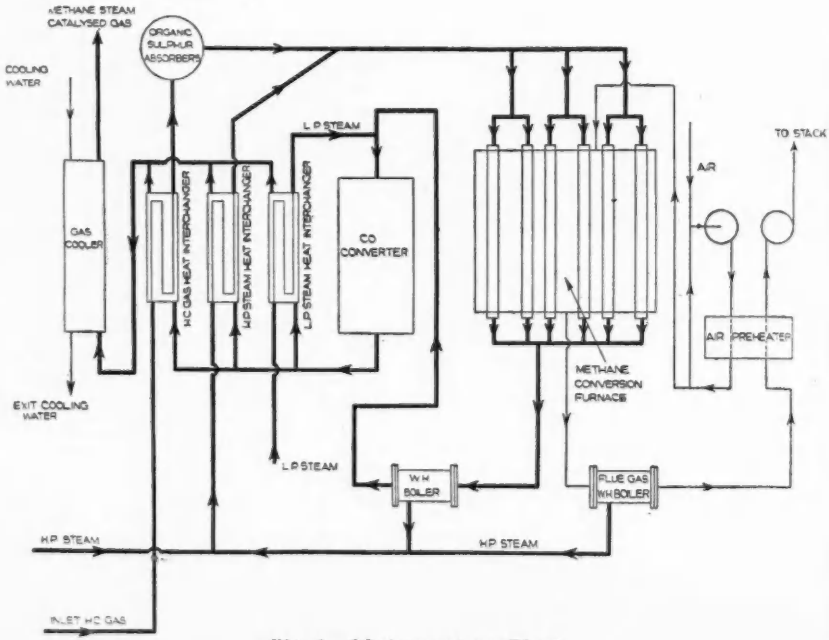


Fig. 1. Methane-steam Plant.

hydrocarbon gas—is treated with steam in the presence of a nickel catalyst to give almost complete conversion to hydrogen and carbon monoxide. By the addition of a second reaction vessel at a lower temperature, with an iron-chromium catalyst, the CO in the " reformed " gas can be used for the generation of a further supply of hydrogen.

The first commercial plants built for this process were at Bayway and Baton Rouge, and serve oil hydrogenation units built by the Standard Oil Company of New Jersey. With their design as a basis, considerable experimental work was carried out at Billingham, including the operation of a full-size reaction tube. As a result it was decided that a unit with 66 standard 6-in. tubes, which for some reason appears to be universally employed as a standard unit, had a capacity of 12,000 to 15,000 cu. m. per hour—nearly three times that originally contemplated. The unit at Billingham took advantage of this higher output and also had added to it very complete heat-recovery arrangements. A similar, but improved, unit was built at Heysham, and this was the prototype for several others which were built in Canada and in the United States.

Fig. 1 is a flow diagram of the Heysham methane-steam unit, and is self-explanatory. Table V gives the operating conditions for this unit. The process is very simple and easy in operation. It requires the minimum amount of attention and repairs and has a high thermal efficiency. The overall thermal efficiency shown in Table V, it will be noted, is 73.8 per cent.

Since the hydrogenation operations at Billingham have been restricted to the vapour-phase units, the methane-steam units have been closed down. This is because the vapour-phase process produces for practical purposes only propane and butane, which are both fully utilised for other purposes, leaving no raw material for the methane-steam units. It is only when liquid-phase hydrogenation, with its relatively high proportion of methane and ethane, is employed, or when there is an extraneous source of hydrocarbon gases, such as natural gas, that

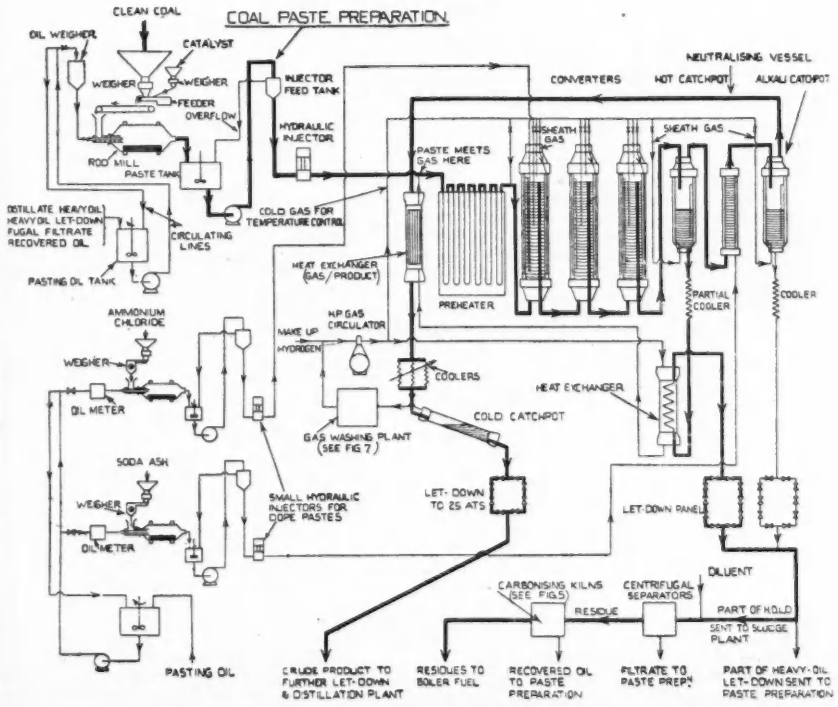


Fig. 2. Coal Hydrogenation.

the methane-steam process is required in conjunction with hydrogenation.

Fig. 2 is a flowsheet of the coal hydrogenation stalls as originally arranged at Billingham. The coal paste made as described on a previous occasion is injected by means of hydraulically operated injectors. It will be seen from the diagram that subsidiary injectors are required for the injection of a paste of ammonium chloride in oil, and for the paste of soda in oil which is required for the subsequent neutralisation of the vapours. This neutralisation step requires a second hot catchpot and let-down panel.

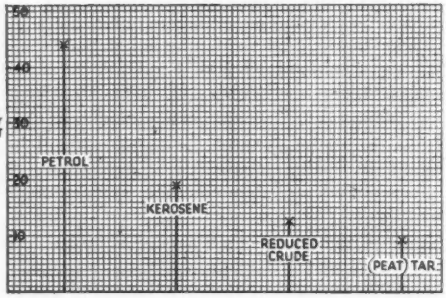


Fig. 3. Solubility of hydrogen in different oils at 240 C.

When the first unit was operated it soon became apparent that the degree of hydrogenation effected was less than at first anticipated by experimental results in semi-technical plants. Part of the difficulty was traced to the relatively high proportion of the cross section of the converter occupied by the hydrogen passing through the coal oil burden contained in the converter. This difficulty was largely overcome by reducing the number of converters per stall from three to two, with corresponding diminution in throughput. A device subsequently employed was the provision of four converters per stall, but with two parallel paths through the heat exchangers, preheater and converters. Even with these arrangements it must be recorded that the yields are still not so good as could be obtained in semi-technical plants, and the reason for this discrepancy is still partly unexplained.

One contributing factor is believed to concern the catalytic effect of surfaces. It is certain that the walls of small experimental converters display a highly catalytic effect after they have been operated for some time, and in big-scale converters exposed surface to reaction volume is, of course, much less. Reduction of the surface effect in large-scale operation would be expected to increase the yield of unreacted coal and to increase the make of high molecular weight intermediate hydrogenation products or asphalts.

A second difference between semi-technical and large-scale operation is that in the former it is impossible to avoid entirely some accidental purge of these asphaltic products, as, for example, in the form of samples of crude product required for analysis. The reduced catalytic effect of surface, combined with a small asphalt purge, has the result that in large-scale operation the equilibrium asphalt content of pasting oil, and, consequently, of the reacting burden in the converters, is higher than is the case in semi-technical work.

The hydrogenation of coal clearly takes place at the interface between the coal and the oil in which it is suspended and, to a relatively minor extent, between the coal and the gaseous phase directly. The governing factor is therefore the solubility of hydrogen in oil, which, as shown in Fig. 3, decreases with increasing complexity of the oil. Incidentally, in this connection it is interesting to note that the main reason for hydrogenation being at all possible is that solubility of hydrogen in all oils is increased by increase of temperature, as illustrated in Fig. 4. Usually gas solubilities show the reverse relationship.

It will be appreciated from the foregoing that the introduction of any factor which reduces, even to a slight extent, the degree of hydrogenation sets up a "snowball" effect by reducing the concentration of reacting hydrogen, and it is therefore not surprising that coal hydrogenation is one of the most difficult reactions from the standpoint of correlation of semi-technical and large-scale results.

It was our original intention to carry out the coal hydrogenation reaction in two liquid-phase stages, the first producing petrol, middle oil and distillate heavy oil, and the second converting the heavy oil into a middle oil and petrol under optimum reaction conditions. On the large scale it was found that employment of the relatively mild conditions required for production of excess heavy oil in the first stage led to an excessive build-up of asphalt in the recycle oils, and it was thefore necessary to revert to

single-stage conditions—that is to say, conditions in which the production of heavy oil in a single-stage treatment was little more than that required for making up the coal paste.

The treatment of the heavy oil let-down, which contains the unconverted coal, the asphalt and the ash, gave not unexpectedly considerable difficulty at first. The original method adopted was as follows: Part of the heavy oil let-down was recycled and used as pasting oil. The balance was first mixed with asphalt-free heavy oil obtained from the cold catchpot product and treated to a continuous centrifugal process, the object of which was to dissolve part of the asphalts, leaving a concentrate consisting of about 45 per cent of ash and unconverted coal. This residue was treated for oil recovery in an apparatus devised by the I.G. and known as a "Kugelofen." In this plant, which is illustrated in Fig. 5, the residue is treated in a revolving kiln with superheated steam. The kiln is heated externally and is partly filled with iron balls which break up the carbonised material as it is formed on the walls of the kiln. These units, as might have been expected, require high maintenance and cannot be said to have been very successful. In particular, it was found that they would only operate satisfactorily with a feed containing a low ratio of asphalt to solids; otherwise they were rapidly choked with a plastic intermediate product of carbonisation. The use of the kilns thus provided only a very small purge of asphaltic material, and therefore accentuated the general asphalt troubles which have already been discussed.

In the end it was decided to do away with the dilution, fugalling and kiln carbonisation process, and to employ a much simpler procedure for the purge of ash and unconverted coal. The appropriate quantity of

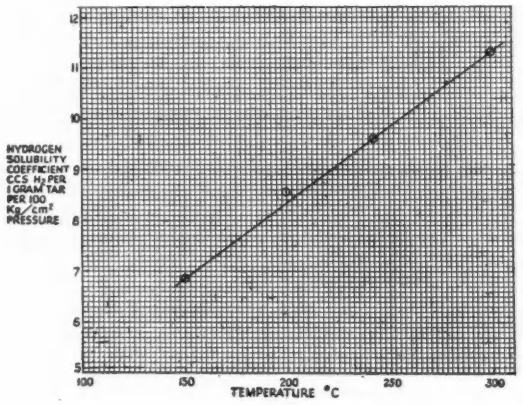


Fig. 4. Solubility of hydrogen in peat tar.

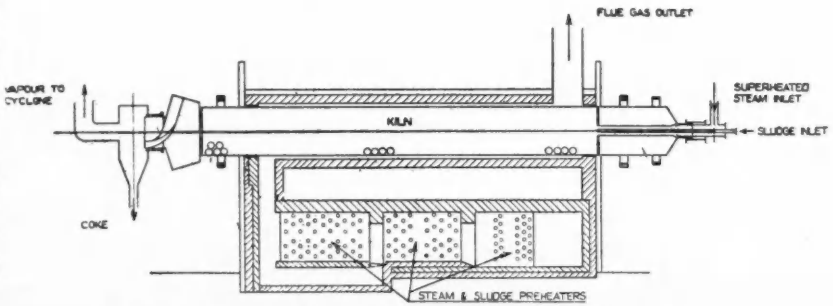


Fig. 5. "Kugelofen" for treatment of hydrogen plant residues.

heavy oil let-down was fed direct to the flash distillation plant illustrated in Fig. 6. In this plant the residue is heated and flashed into a chamber from which the vaporised oil is withdrawn, and passes into a cooler while the unvaporised residue falls into a trough of water, in which it coagulates into a material which it is possible to burn. Although the oil recovery which is possible by this simplified process is not nearly so great as is theoretically possible with the earlier method, the process is much more practical and economical in operation.

Table VI gives the operating conditions for coal hydrogenation. The overall position is represented in Table VII.

Taking 98 per cent and 95 per cent respectively as the yields of final petrol from coal petrol and middle oil, the final petrol yield is 51.5 per cent on a.m.f. coal. This figure could be increased by working up hydrocarbon gases to petrol. These figures only deal with the coal used for hydrogenation itself, and exclude that required for production of hydrogen, power and steam. The process is so interlinked at Billingham with other activities that no direct figure is available. At a separate hypothetical factory, the figure depends upon the methods used—for example, the extent to which the methane-steam process is depended upon for hydrogen manufacture. Five to six tons per ton of petrol is a fair figure.

In the original layout at Billingham, one stall with three converters was reserved for the hydrogenation of surplus heavy oil from coal hydrogenation. It was also used for the treatment of the heavy oil fraction of creosote oil. Whilst coal hydrogenation was in progress it was found preferable in practice to use creosote heavy oil as part of the oil required for preparing the coal paste, and to use as the feed to this liquid-phase stall a corresponding quantity of coal stall heavy oil product. The reason for this was that the creosote heavy oil contained a small amount of alkali which had been left in the oil as a result of the extraction of tar acids. Alkali has a deleterious effect on hydrogenation.

The stall for heavy-oil hydrogenation was identical with that used for coal hydrogenation, except that the arrangements for injection of ammonium chloride and for neutralising the hydrochloric acid in the vapour were not provided. An addition was that a hot circulating pump was included to recirculate the oil from the hot catchpot back to the converer. Fig. 7 shows the flow diagram of the stall, and Table VIII gives the average operating conditions for creosote oil; coal heavy oil gives very similar results.

The catalysts used for this reaction were tin oxalate and iodine. The concentration of the latter had to be kept low both on account of cost and in order to avoid corrosion troubles. Enough carbon tetrachloride to effect neutralisation of traces of alkali was also added. With this restricted

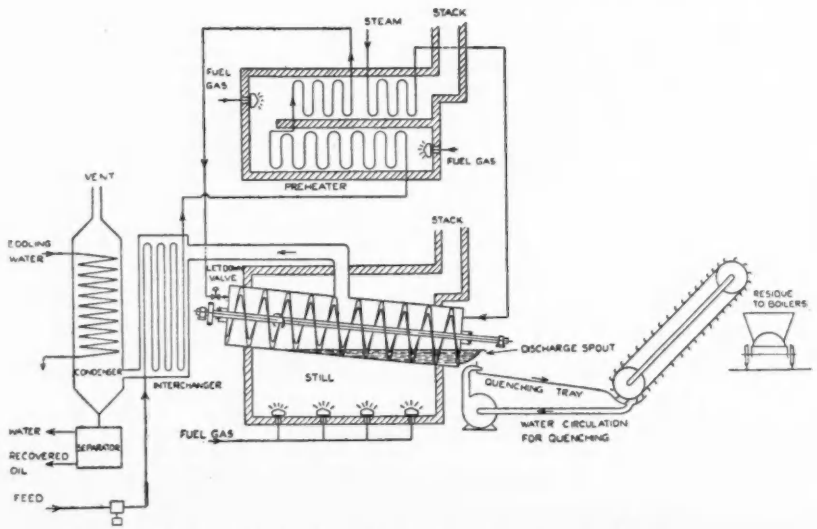


Fig. 6. Distillation of hydrogenation plant residues.

TABLE VI.

OPERATING CONDITIONS FOR COAL HYDROGENATION.

Coal content of paste :	47 per cent by weight
Consumption of tin oxalate catalyst :	0.02 per cent by weight on paste feed
Consumption of NH_4Cl :	0.2 per cent by weight on paste feed
Paste feed rate :	0.5 tons per m^3 reaction volume per hour
Coal (a.m.f.) feed rate :	0.215 tons per m^3 reaction volume per hour
Average converter temperature :	465 °C
Average converter pressure :	265 atmospheres
Average hydrogen partial pressure :	189 atmospheres
Hydrogen content of inlet gas :	84 per cent by volume
Hydrogen content of exit gas :	76 per cent by volume

FLOWSHEET DATA

(all figures in tons)

	a.m.f. coal	Ash	Water, NH_3, H_2S, HCl	Unconverted coal	Heavy oil over 335°C	Middle oil 180-335°C	Petrol 0-180°C	Hydrocarbon gas	Nitrogen	Hydrogen	Unaccounted for loss	Total
Ingoing materials												
Coal	100.0	3.3	5.4	—	—	—	—	—	—	—	—	108.7
Pasting oil for coal	—	6.3	—	11.6	100.4	4.0	—	—	—	—	—	122.3
Ammonium chloride and sodium carbonate	—	0.4	0.3	—	—	—	—	—	—	—	—	0.7
Pasting oil for NH_4Cl and Na_2CO_3 ...	—	0.3	—	0.5	3.0	—	—	—	—	—	—	3.8
Recycle hydrogen	—	—	—	—	—	—	—	22.4	47.8	32.8	—	103.0
Hydrogen make-up	—	—	—	—	—	—	—	0.4	4.7	9.3*	—	14.4
TOTAL ...	100.0	10.3	5.7	12.1	103.4	4.0	—	22.8	52.5	42.1	—	352.9
Primary products												
Recycle hydrogen	—	—	—	—	—	—	—	22.4	47.8	32.8	—	103.0
Gas purge via gas washing ...	—	—	—	—	—	—	—	19.1	3.5	0.7	—	23.3
Gas purge from hot catchpot let-down ...	—	—	—	—	—	—	—	0.9	0.4	0.1	—	1.4
Gas purge from cold catchpot let-down ...	—	—	—	—	—	—	—	3.3	0.8	0.2	—	4.3
Heavy oil (hot) let-down ...	—	9.6	—	17.6	57.8	—	—	—	—	—	—	85.0
Second hot let-down	—	0.7	—	0.5	10.8	—	—	—	—	—	—	12.0
Cold catchpot product ...	—	—	13.4	—	41.3	46.6	11.4	5.1	—	—	—	117.8
Loss	—	—	—	—	—	—	—	—	—	—	6.1	6.1
TOTAL ...	—	10.3	13.4	18.1	109.9	46.6	11.4	50.8	52.5	33.8	6.1	352.9
Net makes from 100 t. a.m.f. coal	—	—	7.7	6.0	6.5	42.6	11.4	28.0	—	8.3	6.1	—
Final products												
Recycle hydrogen	—	—	—	—	—	—	—	22.4	47.8	32.8	—	103.0
Lean gas ...	—	—	—	—	—	—	—	14.1	3.2	0.7	—	18.0
Rich gas ...	—	—	—	—	—	—	—	11.5	1.0	0.2	—	12.7
Heavy oil let-down (to paste)	—	6.5	—	11.8	38.9	—	—	—	—	—	—	57.2
Filtrate to paste	—	0.1	—	0.3	9.5	—	—	—	—	—	—	9.9
Recovered oil ex sludge (to paste)	—	—	—	—	13.7	—	—	—	—	—	—	13.7
Heavy oil ex cold catchpot (to paste)	—	—	—	—	41.3	—	—	—	—	—	—	41.3
Sludge residues	—	3.7	—	6.0	5.9	—	—	—	—	—	—	15.6
Petrol	—	—	—	—	—	—	11.3	—	—	—	—	11.3
Middle oil ...	—	—	—	—	—	46.4	—	—	—	—	—	46.4
Liquor	—	—	13.4	—	—	—	—	—	—	—	—	13.4
Loss	—	—	—	—	0.6	0.2	0.1	2.8	0.5	0.1	6.1	10.4
TOTAL ...	—	10.3	13.4	18.1	109.9	46.6	11.4	50.8	52.5	33.8	6.1	352.9
Net yield of final products from 100 t. a.m.f. coal ...						42.4	11.3	25.2				

* This is a weight proportion : the hydrogen used was 96 per cent. purity by volume.

use of iodine the rate of hydrogenation was not as great as could be desired. Improved results could be obtained by introduction of anti-corrosion and iodine recovery measures when the concentration of this catalyst could be increased. Alternatively it should be possible to find conditions under which active catalysts of the tungsten sulphide type might be used for this reaction. Considerable work has been carried out at Billingham on the possible utilisation of active catalysts, and it is concluded that a necessary condition is the complete removal of asphalt and solids from the feed oil. The only stall we have operated under such liquid-phase conditions was at Heysham, where the saturation stage of what would normally be vapour-phase hydrogenation was in practice carried out in the liquid phase. This will be referred to later.

(To be continued)

TABLE VII.

OVERALL YIELDS FROM COAL.

IN		
Coal—a.m.f	100.0	
Ash and moisture	8.7	
Hydrogen	9.3	
Catalyst material, etc.	0.7	
	118.7	
OUT		
Petrol	11.3	
Middle oil	42.4	
Total oil :		53.7
Hydrocarbon gases		25.2
Sludge residues		15.6
Liquor		13.4
Hydrogen purge to fuel		0.9
Net loss		9.9
		118.7

Italy's leading cement producer, the Italcementi-Fabbriche Riunite Cemento of Bergamo, has recently absorbed the Cementi Artificiali of Genova. In the course of this transaction, the share capital of the Italcementi will be increased from 1805 to 300 million lire.

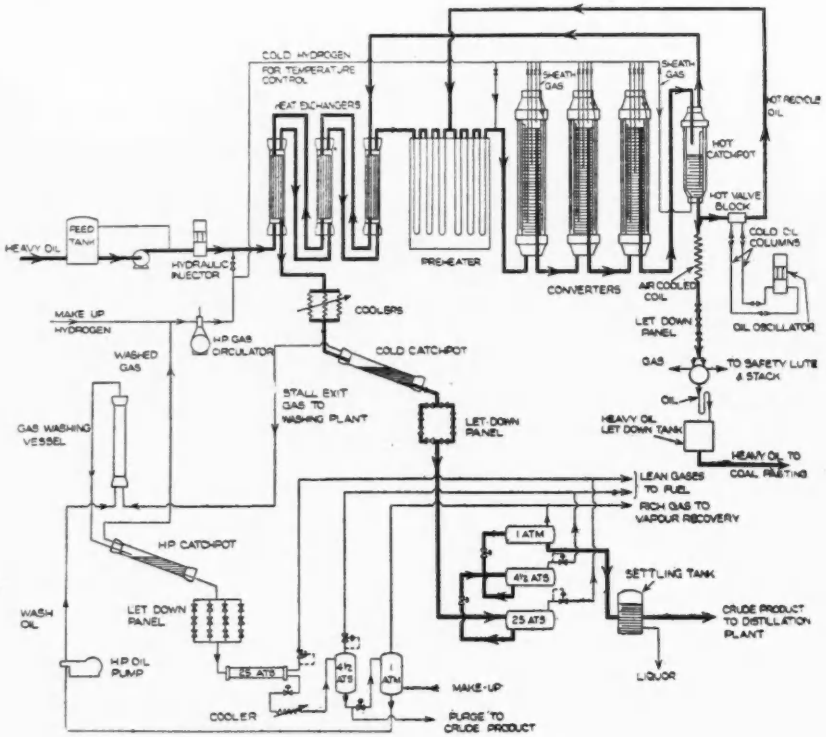


Fig. 7. Liquid-phase hydrogenation of heavy oil.

Modern Water Gas Plant

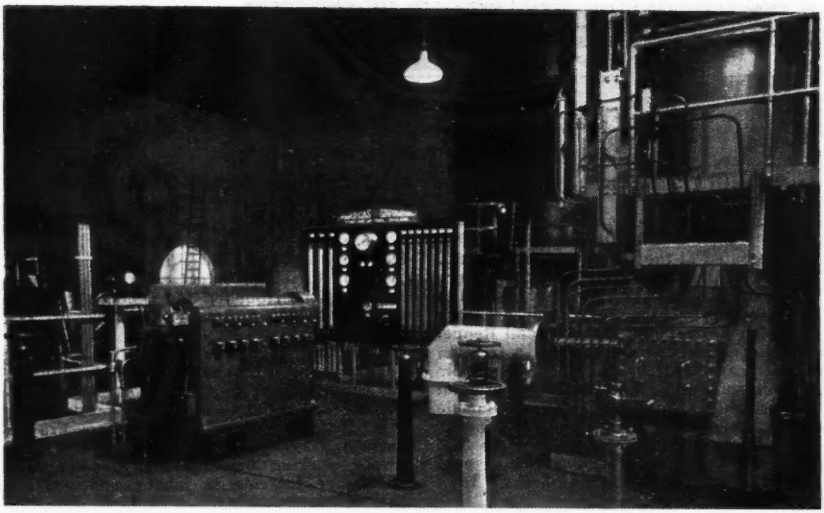
Interesting New Developments

IT is many years since the Power-Gas Corporation, Ltd., Parkfield Works, Stockton-on-Tees, built one of the first water gas plants in the world, with a mechanical self-clinkering grate and automatic ash extraction. It is probable that this innovation, and that of automatic operation, have done more than any other to advance the water gas process from its earlier stages of development to its present state of efficiency, both chemically and mechanically.

The company has now designed and constructed what is claimed to be the most modern type of gas plant, the P.G. Automatically Operated Mechanical Carburetted Water Gas Plant. This type of plant was recently installed by them at the South Suburban Gas Company's works at Lower Sydenham, S.E. In Leaflet CWG846, just issued by the Power-Gas Corporation, Ltd., this new and up-to-date plant is fully described and illustrated in all its interesting processes. The carburetted water gas plant is especially suited to cope with "peak" loads. It can be set into operation with extreme speed, not more than an interval of hours being necessary before full production can be achieved from cold. The gas make can be regulated as required, down to a fraction of rated output, while maintaining uninterrupted production.

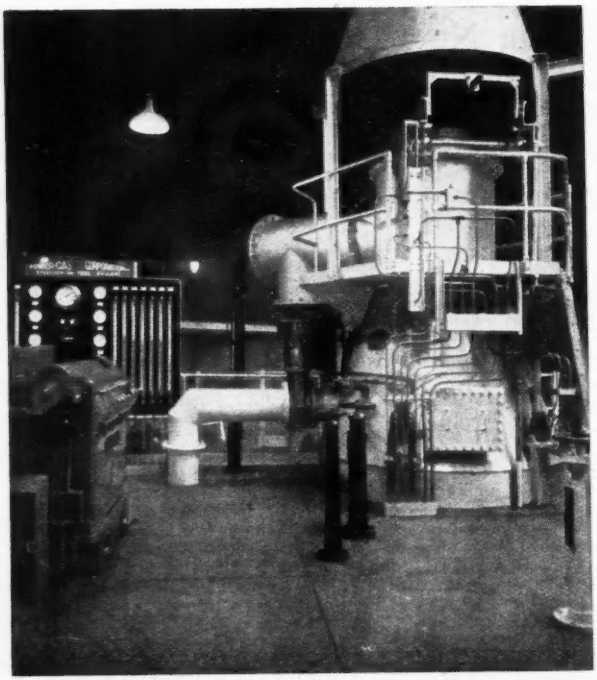
On the other hand, the water gas plant can be set to "stand-by" and maintained ready for immediate re-operation. This obviously is of much importance in a town's gas industry, upon which "peak" load demands often attain abnormal levels. The variation in calorific value which can be achieved at will with carburetted water gas, and the high flame temperature of the gas, are further qualities of value for all industrial heat applications.

Essential features of the modern carburetted water gas plant is the generator in which the fuel is gasified, the carburetter in which the blue water gas is mixed with oil vapours, the superheater for fixing the oil vapours, and in many cases a waste heat boiler. The plant is usually designed to operate on the backrun process by means of which better control over temperature conditions in the various vessels can be maintained efficiently and maximum advantage taken of the available heat in the blow gases, thereby economising in fuel consumption. The operation follows a carefully



View of operating platform, showing automatic hydraulic operator and instrument panel.

prepared cycle, two, three or more minutes in length and usually made up of five phases; blow; blow purge; initial uprun; backrun; final uprun.



Top portion of superheater at operating platform level

Belgian Lead and Copper

Difficulties in Refining Industry

DIFFICULT conditions in the Belgian non-ferrous metals refining industry were outlined in the annual report of the Societe Generale Metallurgique de Hoboken, presented at the recent annual meeting. While activities of the electrolytic refinery and chemical plants at Oolen have steadily improved during the year, and are now practically normal, the Hoboken and Reppel plants have been operated at only a fraction of their capacity. It had been impossible to obtain sufficient quantities of lead ore and cupriferous materials to secure economic operation of the Hoboken plant, and it was only within the last few weeks that the first quantities of cassiterite and unrefined gold to be delivered since the war arrived from the Congo.

Supplies of crude copper for the Oolen plant from the Union Miniere du Haut-Katanga and, to a less extent, from other sources, has permitted practically normal operation of the electrolytic refinery, while the Union Miniere has also provided cobalt ores sufficient to utilise nearly half the capacity of the plant. The Reppel plant, manufacturing arsenical salts from by-products of the Hoboken and Oolen plants, has been seriously affected by lack of raw materials.

The raw material position is improving and will, it is hoped, continue to improve as shipments from the Union Miniere increase and contacts with other producers in the Belgian Congo and elsewhere are resumed. Owing partly to the fact that plants were working below capacity, and partly to heavy increase in labour and material costs, the year closed with a slight loss of 107,250 francs, and no dividend could be distributed. All war damage had, however, been written off

SAFETY FIRST

Amenity as a Feature of Chemical Plant—V

by JOHN CREEVEY

ACCORDING to my dictionary, amenity is a matter of things being pleasant; of the situation in which one lives or works having features which make it pleasant for living or working. Recalling conditions observed when visiting numerous chemical and allied works, it is a little difficult to point to any particular amenity which demanded improvement, because conditions change so much from works to works, yet very high on the list comes the avoidance or actual removal of impurities which pass into the air as a result of the intensive working of plant. An inadequately-ventilated atmosphere is bad enough of itself for working in, but when dusts, fumes, and vapours are also present it becomes far more unpleasant. The resulting falling-off in efficiency of the individual workers has never been properly measured, yet such figures would certainly be enlightening.

As regards the dispersion of contaminating material into the outside atmosphere of the works, it should be understood that the actual design and installation of any exhaust system is a matter for the practical engineer. All that may be done here is to offer advice on how best to attack the problem.

Solid and liquid particles will disperse by the kinetic energy of their own motion if they are large enough and are thrown off with sufficient velocity. If such particles are truly microscopic in size, their dispersion relies mainly upon the movement of the air in which they are suspended. For vapours and gases, on the other hand, the linear velocity making for diffusion does not usually exceed one foot per minute, and is therefore unimportant as a dispersing force. Accordingly, as they are lighter or heavier than air, they rise or fall in the air relative to the position of their source, but unless the difference in density is considerable, the rate at which they escape is not high; in consequence, the nuisance they cause may quickly increase in intensity or at least persist for a considerable time.

Dangers from Vapours

Vapours which are particularly heavy constitute a very grave menace, because they are likely to collect in pockets of high concentration wherever conditions are favourable. The chief safeguard against this is the avoidance of air stagnation by good methods of ventilation. If the vapours or gases are of approximately the same density as the air into which they escape, they are dispersed to a relatively high degree by the mere movement of the air.

In all exhausting systems for reducing the nuisance and attendant hazards of impurities in the air, the object of the exhaust hood is to collect the contaminated air rather than to remove the contamination from the air. The hood, in turn, allows the contaminated air to be conveyed through ducts to a convenient point of dispersion in the outer atmosphere, where its ill-effects are no longer suffered, or where it may be treated (if necessary) to render it harmless. But equally important, apart from the hood, its size and precise situation, is the control of air motion. In the first place it is necessary to eliminate all possible air currents which are otherwise unessential to the maintenance of adequate ventilation; secondly, it is necessary to reduce the velocity of air currents immediately adjacent to hazardous processes, or at least in the vicinity of a point where dusts or particles of liquid, or vapours or gases, escape into the air. Insofar as air currents cannot be eliminated, or have their velocity appreciably reduced, they must be put under control and made to flow into the exhaust hood.

Movement of Air

A study of the sources of air movement in the vicinity of industrial processes will reveal the complicated nature of the problems which are likely to arise. In some cases the movement of the air is fundamental to the machine or the process, as where there is fan-action from a rotating wheel, or where screens are in vibration, or there is mere escape of air as containers are filled by liquid. In other cases the air may derive its initial movement from forces incidental to the operation of a particular machine; for example, there may be badly placed exhaust ports, undue vibration of machinery, etc. A third source of air movement comes from the drag of air by large particles which are dynamically projected, as where a stream of sparks is thrown tangentically from a grinding wheel and the resulting air current in the same direction disperses the dust from the wheel. Fourthly, there are sources which may be considered truly external to the machinery or process, as where convection currents arise, or open conveyors are in operation, or perhaps uncontrolled draught from without.

Better conditions as regards air movement in the immediate vicinity of a point where impurities enter the air are easy to effect if the conditions are carefully studied. A slight alteration may be needed in the operation of the process; the removal of external sources of air motion may be indicated, or the shielding of hazardous processes from such air currents, as where improvement is effected by enclosing nearby moving belts, or enclosing "open" conveyors and elevators. It is also possible to prevent the machinery (likewise the process) from creating undesirable movement of air, by enclosing certain parts and shielding others. The fan-action of a grinding wheel can be adapted for the collection of its own dust; a vent may be provided for the safe escape of air from mixers, storage bins, and containers as they are filled with either powdered material or some volatile liquid.

Vibration

The movement of air due to unnecessary vibration of machinery can be avoided by providing proper foundations, and otherwise giving attention to machine design; here, incidentally, another amenity arises in the elimination of noise, which can be irritating to the worker, but sometimes equally rhythmic. The problem of completely eliminating air movement, however, is a difficult matter, although conditions rarely necessitate such a course; it is the improvement of conditions which should be the main aim, in order that the subsequent collection and removal of the contaminated air may be done most effectively before the impurities thrown into the air are able to become more of a menace.

Hoods for the collection of contaminated air have to be correctly designed for the place in which they are used, and for other conditions. The air velocity towards the hood has to be high enough to counter any outward velocity of contaminated air, and that demands the least possible total rate of air-flow. Actual measurements may have to be made, the desirable rate of airflow being determined experimentally by varying conditions until quantitative tests show them to be at the optimum for satisfaction.

Apart from exhaust pipes or ducts to convey the contaminated air to a safe point of dispersion, it may also be necessary to install air-cleaning plant. This is dictated by the need to prevent the creation of a nuisance or a hazard in the immediate vicinity of the outlet from the exhaust system; the need to prevent the re-contamination of plant air from outside; and perhaps to allow the recirculation of air discharged from the exhaust system. The concentration of the contaminating material in the discharged air coming from the exhaust system must never be high enough to create a hazard, and strict control by periodical testing has to be practised for that purpose. Where dust is present it must be collected by use of cyclone extractors, unless the amount present be negligible; dangerous vapours must be destroyed by scrubbing the discharged air, or by burning it. The disposal of collected dusts, etc., must be done without exposing the workmen to any incidental hazard. At times the dust may be exceptionally dangerous to handle in the absence of proper precautions being taken.

The disposal of contaminated air is most simply carried out by passing it through a high chimney. Here dilution with clean air, and ultimate dispersal by favourable wind currents, certainly allow concentration to be reduced to a safe level, yet so much as regards the efficiency of this means of disposal depends upon local conditions from day to day. Even in a fully isolated situation there may be eddies in the air which result in a return of the contaminated air to ground level; the eddies, with their resultant downdraught, are more likely to occur in a built-up factory area, and the nuisance may have serious repercussions when contamination from one works falls upon another works adjoining. In any case, even when the exhausted air is discharged through a tall chimney, it is still necessary to remove all solid particles which are large enough to settle out by aid of settling chambers, cyclones, and other means of inertial separation.

Fine Dust Danger

One point still needs emphasis. By means of primary dust separators it may be fairly simple to remove large particles of dust carried in the exhaust air, yet such means of separation may fail to remove minute particles which may constitute a serious health hazard in favourable situations. From the works amenity viewpoint it is therefore desirable to do all that is possible to prevent the production of dust in any operation which is necessary for the continuance of a chemical process; likewise, to prevent the escape of dangerous vapours and gases into the works atmosphere. In this connection much can be achieved by giving careful attention to the selection of machinery and plant accessories, as also by the adoption of a rigid plant maintenance programme. Good maintenance of plant parts does a great deal to attain pleasant conditions for plant personnel.

A Russo-Danish trade agreement provides for the export, by the U.S.S.R., of 100,000 tons potassium fertiliser, 3000 tons pig-iron, 2000 tons gypsum, 100 tons antimony and 10 tons of silver. The export of oil derivatives and of metals is also envisaged.

Carbon Black Suspensions

Thixotropic Properties

AT a meeting of the London Section of the Oil and Colour Chemists' Association, held at 26 Portland Place, London, on December 4, Dr. J. E. Arnold read a paper entitled "Some Rheological Properties of Carbon Black Suspensions." Mr. R. J. Ledwith, chairman of the section, presided.

Dr. Arnold devoted the main part of his lecture to an account of some unpublished work, carried out in 1939, on the thixotropic properties of suspensions of carbon black in non-polar paraffin, containing very small additions of a third component. He said it is unfortunate that rheologists have not yet evolved a generally accepted formal definition of the term "thixotropy." In the industries with which the association was concerned, it had been his experience that technical staffs had, for the most part, extremely vague and comfortably accommodating ideas as to what constitutes thixotropic behaviour. He added that of those classes of fluids which do not obey the ordinary Newtonian laws of flow, those which possess rigidity (i.e., a yield value) when at rest, and show an isothermal, reversible decrease in viscosity with increase in rate of shear would, for the purpose of this lecture, be regarded as thixotropic, although he was aware there were other ideas on the subject.

Effect of Third Component

Having dealt briefly with the technique and apparatus, and given some of the results obtained with the simple two-component system, carbon black/non-polar paraffin, Dr. Arnold dealt in more detail with the behaviour observed when a third component was added to the system. He said that the use of such compounds as oleic, linoleic, and benzoic acids, and of blown oils and stand oils to reduce the thixotropic tendencies of paints and printing inks was well known, and there were many references to such behaviour in the literature. It was frequently assumed that such added substances assisted the wetting of the dispersed pigment by the medium and that the greater the extent of such wetting the less the degree of thixotropy. Such an assumption, however, appeared to ignore the fact that the literature also described a number of instances where the reverse effect was observed, using the same or similar added substances.

He then discussed the effect of the third component on "residual viscosity" and the "coefficient of thixotropy," and described a series of tests.

The effect of concentration of the third component was also discussed, the general types of behaviour to be expected having been ascertained, and the results were shown in a series of curves.

Discussing the results of the tests, Dr. Arnold said that much confusion still seemed to persist in the technical literature as to the meaning of the terms "wetting" and "dispersion." His views coincided with those expressed by Dr. Bowles in a paper before the Association in January 1938. By "dispersion" was signified the mechanical process by which large aggregates of pigment particles were broken up and distributed more or less evenly throughout the medium. A dispersing agent could only be a piece of machinery. "Wetting," on the other hand, was understood to involve the adsorption of molecules of the medium on the surface of the suspended particles. Good "wetting" was thus effected when strong adsorption occurred, and vice versa.

Thixotropy and Welting

No one would deny that carbon black was poorly wetted by liquid paraffin, or that oleic acid, for example, was a good wetting agent for many pigment/vehicle dispersions. Yet in the work he had described, there were three sets of circumstances in which the coefficient of thixotropy was respectively increased, unchanged and decreased by the addition of a good wetting agent. If, therefore, it was to be stated that thixotropy implied poor wetting and vice versa, it must be assumed that in those cases where the residual viscosity was either unaffected or increased by the addition of oleic or palmitic acid, these substances were not acting as wetting agents; in other words, they only did so when the residual viscosity was lowered. Alternatively, it must be deduced that thixotropy was not necessarily bound up with the wetting at all.

Experiments

In the course of the discussion, Dr. R. F. Bowles said that wetting was not simple and in nearly all cases—and particularly with carbon black—they were displacing something from the carbon. Experiments carried out in the laboratories with which he was associated indicated quite clearly that with carbon black, this displacement, which was thought to be water, went on even in a well dispersive medium such as stand oil, and his experiments had shown that after four minutes this gradual displacement went on and the dispersions were becoming more and more fluid and were breaking down the structure. The American workers had pointed out that very small traces of water could induce thixotropy.

Chemical Aspects of Silage-Making

Address in Dublin by Professor A. I. Virtanen

ADDRESSING the Royal Dublin Society on December 10, on "The Ensiling of Green Fodder," Professor A. I. Virtanen, Director of the Biochemical Institute, Helsinki, and 1945 Nobel Prizeman in chemistry, dealt with the chemical aspects of silage making.

He said that there were three ways by which decomposition of nutrients was caused during conservation of fresh fodder: (1) Respiration of plant cells, whereby carbohydrates were lost; this occurred only at the start of conservation; (2) detrimental fermentation, whereby carbohydrates were decomposed by micro-organisms and organic substances lost by cleavage of carbon dioxide; (3) protein breakdown caused by micro-organisms, which partly led to cleavage of ammonia from amino acids.

The problem was to prevent these processes and yet not make the fodder nutritionally deficient. Of the two means of achieving this, one was by inhibition of the processes by bactericidal substances, and the other, by the adjustment of the hydrogen ion concentration, popularly called the acidifying of the fodder mass to a definite value.

Importance of Acidity

Laboratory experiments had shown that the acidity of the fodder remained constant for an unlimited time if the acidity of the fodder mass was raised at the time of ensiling by an addition of sufficient acid to a *p*H value between three and four, and the effluent was allowed to drain off. If the addition of acid was insufficient and the *p*H of the fodder mass remained over four, the detrimental processes were no longer arrested. Formation of ammonia, and lactic acid fermentation to butyric acid then started, raising the *p*H of the silage and giving further opportunities for decomposition. It appeared that *p*H4 was the lowest acidity at which fodder could be conserved with certainty. Drainage of the effluent from the silo was vitally important since the *p*H of the fodder lying in solution rose and decomposition set in.

Quantitative tests of the acid required for adjustment of the proper *p*H of the fodder showed that fewer strong acids were needed than weak ones and that acid requirements varied for different forage plants. The higher the protein content of the plants, the greater their requisite amount of acids. The acid and lime content of the soil also effected the acid requirements.

As material losses in silage could occur only through effluent or by evolution of gases, an apparatus for the collection of gases and effluent was devised. The only gas found, at any rate in silage below *p*H4, was carbon dioxide, which was first formed partly through respiration and partly through fermentation. The amount of carbon dioxide formed indicated, not only the loss of organic substances, but also the extent of detrimental fermentations.

Amino acids constitute the physiologically important compounds of protein. If the decomposition did not pass the amino acid stage, the value of the protein did not change, if the present scientific conception was right. A clear idea of the decomposition of proteins was obtained by determining how much ammonia was formed from the total nitrogen during the conservation.

The wholesomeness of the acidified silage was tested in various ways. The results of the analyses from different parts of bones, teeth and tissues did not show anything exceptional. The calcium, phosphates and chlorine content of the blood were normal. The only change was in urine, the reaction of which changed from alkaline to acid. The combined carbon dioxide was simultaneously decreased and the ammonia content increased. But this was corrected by the use of soda and limestone mixture in feeding.

A New U.S. Insecticide

Rival to DDT

A NEW insecticide toxicant, Toxaphene, has been announced by the Hercules Powder Company, of Wilmington, Delaware. Preliminary tests indicate that Toxaphene is fully as effective as DDT against some insects and more effective against others. Toxaphene is a chlorinated camphene. For the past 18 months it has been undergoing tests in more than 75 different places throughout the United States under the name of Hercules Synthetic 3956.

These extensive tests indicate that it can be used effectively in agricultural, household, and industrial insecticides. It is reported to be effective against such insect pests as cotton insects, tobacco horn worm, Mexican bean bettle, flies, clothes moths, and roaches.

Toxaphene can also be combined with Thanite, a toxicant possessing "knockdown" properties, for use where both quick knockdown and residual properties are desired. Toxaphene is, at present, available only to qualified testing agencies for experimental use.

SOUTH AFRICAN CHEMICAL NOTES

(From our Cape Town Correspondent)

MANUFACTURERS of heavy and other industrial chemicals in the United States and Canada have been showing increasing interest in the South African market and recently several new agents were appointed in Johannesburg and Cape Town, among other centres, to push the sale of such products in the Union.

This has not meant any slackening off in the demand for similar chemicals from Britain, for the state of the South African market at present is such that it can absorb most of the various types of chemicals that Britain can export to it, despite increasing competition in certain directions from local manufacturers.

With a few exceptions, however, South African chemical manufacturing is more of a mixing industry than a manufacturing industry, for it is still necessary for many of the so-called local chemical industries to import large quantities of processed or semi-processed chemicals.

Aerial Spraying of DDT

Dr. R. du Toit, ex-president of the South African Biological Society, in an address to the Pretoria branch, said that two weeks after the last of a series of three DDT sprayings of the Mkusi area of Zululand, carried out by aircraft at the end of last year, the number of tsetse flies caught in traps in that area had dropped to only 7 per cent of the pre-spraying total. From about the end of March of this year, however, a gradual increase in the number of flies had occurred. The figures had not reached the pre-spraying numbers by the time this year's operations were started. In these operations, using a new method, daily catches of flies dropped from between 150 and 200, before the first spraying early in August, to 10-15 after it.

Hydrolysed Protein

A plant for the production of hydrolysed protein by a process devised by Col. H. Watkins-Pitchford, C.M.G., has been established on the premises of the Premier Whaling Company, Durban, by the Natal branch of the South African Red Cross, and is now in operation. The flesh of both whales and oxen could be used with equally good results. Beef that is normally unfit for human consumption is entirely satisfactory for the raw material of the process, and it is hoped that the use of such beef will create a new market for uneconomic "scrub" cattle.

The whale meat, under the existing conditions of food shortage throughout the world, would be a valuable source of nutriment not now being fully utilised; it is practically indistiguishable from that produced from beef. Protein would be incorporated in various forms of foodstuffs and there is a likelihood that this would result in the establishment of new industries in the Union for the production of invalid food, biscuits, toffee, nutrified wine and stout. Hydrolysed protein has had a marked success in the treatment of tuberculosis, malnutrition, and other allied diseases.

Campaign Against Metal Rust

The South African Railways and Harbours Administration will soon save thousands of pounds annually, as a result of a carefully conducted campaign against rust. The campaign is taking the form of the comprehensive testing of hundreds of different paints at various centres in South Africa. When the tests are completed, the railway authorities expect that the "terrific expenditure" on paints and labour to maintain structural steel works such as bridges will be cut to a minimum. Only proved paints will be used, and the ravages of rust will be stayed for years.

An official at railway headquarters in Johannesburg said that railway chemists were taking no chances in their fight against rust. "More than 1000 panels of mild steel are being used in exposure tests to determine the reactions of various paints to atmospheric conditions in Johannesburg, De Aar, Port Elizabeth, Durban, and Umkomass," he said. "These widespread tests will enable the authorities to choose the best rust-resisting paints. In some instances in the past the paints used involved the Government in great expense, because they provided protection against rust for only about three or four months. This unnecessary expense will be avoided in the future. The scheme was instituted in 1939, when three chemists were specially employed by the railways. Their work was interrupted by the war, but now they travel four times a year to the different towns where the tests are being made. Detailed charts of the results are kept, and by the end of this year definite data will have been obtained."

New Coal-Tar Plant

A modern plant for producing tar from coal, which is now being assembled at the Johannesburg municipal gas works, Cottesloe, will increase the municipal revenue derived from the gas works from £20,000 to

£30,000 a year—besides enabling local industries to manufacture perfumes, flavourings, and even substitutes for sugar. The present output of the gas works plant is about 80,000 gallons of crude tar a month. The new plant, which will be ready early next year, will be capable of producing more closely defined "fractions" than the present obsolete stills. It will also enable distillates to be made to meet purchasers' specifications, although the municipality will concentrate on a limited number of products.

The increase in output of coal tar will have a big bearing on local industry because of its many uses. Mr. J. G. Curnow, municipal gas engineer and manager, said that, as an example, nearly every flower perfume and many artificial perfumes could be made from a tar base. This also applied to a number of flavourings, such as vanilla, thyme, violet, almond and cinnamon. In addition, substitutes for sugar, such as saccharine, were derived from tar, as well as dyes and many kinds of explosives. He said that for every ton of coal used in making gas, 12-14 gal. of tar were recovered. Several hundred substances had been identified in coal tar by chemists, he said, and in the primary distillation the oil recovered was usually separated into five categories well known to chemists.

Glass and Enamel

A new £1,000,000 Johannesburg company plans to link with its glass department an enamelling works where castings, particularly baths, basins, sinks and cisterns, will be finished. The purpose of housing the enamelling works adjacent to the glass department is to make use of waste heat from the glass-melting furnace to pre-heat the castings prior to their entering the electrically heated enamelling stoves. This will effect very marked economy in the working of the latter, and will greatly improve the temperature control in the first electrical stove when the ground coat is applied. A high-class enamel has been developed and thoroughly tested, and will be produced from local materials. It is claimed that the cost of this enamel will be but a fraction of that of the imported article, and this, together with the heat economy, will place the company in a strong position to meet competition from imports.

Merchandise Marks

Sections 8 and 9 of the Merchandise Marks Act, which was due to come into force on September 1, have been suspended indefinitely. These sections relate to the compulsory marking of goods not made in South Africa. The two sections were suspended following representations from commercial organisations on the practical difficulties involved in complying with their requirements, and the possible effect on the Union's supply position should compliance be insisted upon at present.

Austrian Plastics

Allied Commission Aids Recovery

A SURVEY of the plastic industry in Austria in 1938 gives an account of more than 100 plastic firms, with about 2500 workers and a raw material value of 25,000,000 marks. The largest works produced a product similar to Bakelite, which was used for various purposes and covered almost the whole home demand.

The picture changed considerably after the annexation of Austria by Germany. The I.G. Farben concern gradually eliminated Austria's production as a result of the stopping of casein imports from Finland and America, and the impossibility of obtaining other raw materials. Only a small production was maintained for war purposes, as long as stocks were at hand, but after the end of the war materials were obtainable from Czechoslovakia and Switzerland.

Extensive research is now being undertaken with a view to the production of new plastics. In the meantime, the gap is being bridged by the Allied Commission placing at the disposal of the plastic industry substantial quantities of nitrocellulose from surplus Army stores. There are many favourable factors to facilitate a recovery of the plastic industry in Austria. Most of the necessary raw materials exist in the country, particularly wood-flour and lignite. Phenol and formaldehyde are lacking at present, but no insurmountable difficulties exist for a home production of formaldehyde, while phenol can be obtained at gasworks. For the present, however, these raw materials will have to be imported: phenol from the coke industries of Czechoslovakia and Poland, and formaldehyde from Czechoslovakia, Jugoslavia, Roumania, and Hungary.

The existing plastic plants, although partly destroyed by bombing, might soon be repaired and set to work with a capacity to supply not only the home market, but also to provide exports. New plants are intended for the production of compression-moulding plastics.

In China a programme has been worked out to provide considerable assistance to growers of tung trees. Production of tung oil is estimated to reach this year only 60,000 tons, or about one-half of the pre-war output.

Potash from the Dead Sea

Palestine Company's Progress

STARTED in 1930, the work of the Palestine Potash Company was greatly widened during the war years, and not only has a great area in the south been added to the larger basin areas north of the Dead Sea, which are connected by a fleet of small vessels, but operating methods have been improved and output greatly increased.

The salts which characterise the Dead Sea are those of potassium and bromine. The Sea is the only lake still "at work," accumulating year after year considerable quantities of these and other salts. The reason for this phenomenon is the fact that the Jordan and its tributaries flow over potassium-containing layers, mainly marls which form the layers on the upper parts of their beds. As for the bromine, there is evidence that the Jordan derives its bromine salts exclusively from the hot springs of the Sea of Galilee which contain bromine, and supply water to the lake.

The Palestine Potash Company was granted a 75 years' concession as from January, 1930, and undertook to produce 1000 tons of potassium chloride in the third year, 1500 tons in the fourth year, and 10,000 tons in the eighth, nine and tenth years respectively. After that the company was scheduled to produce 50,000 tons annually. The company further undertook to employ a certain percentage of labour from Transjordan, to which a part of the Dead Sea is considered to belong. All the conditions of the concession have been fulfilled, and in the eighth year of its existence the company manufactured, instead of 10,000 tons, a total of 63,000 tons of potassium chloride. During the war Palestine was the most important supplier for the Allies and, to meet war needs, production was vastly increased.

Bromine and Bromine Salts

A special branch of the production is devoted to the manufacture of bromine and bromine salts. The Dead Sea is the main source of bromine in the world. Recently the company, with the help of the Hebrew University, developed a new and modern method of extracting the bromine, and especially pure bromine salts. The production of the latter has now become an important part of the company's activities. The fertilising industry takes the lion's share of the potash salts, but the disposal of all the bromine that could be manufactured by the company is still a problem and is the subject of research and investigation.

A first-class staff of chemists working in the well-equipped laboratory in Jerusalem, as well as on the spot at the Dead Sea, are striving to develop additional products connected with potassium and bromine, as well as with magnesium, the importance of which has increased, particularly in the last decade.

There are enormous stocks of magnesium salts in the Dead Sea in a highly concentrated solution, but a magnesium undertaking must be based on the availability of cheap fuel, which in turn depends on the price policy of the oil companies in Palestine. If the price of oil fuel could be kept down to a reasonable level, there is every possibility that the Palestine Potash Company would be able to develop a magnesium metal-producing industry. The company lately announced its intention of participating in the development of the industrial production of other fertilisers, mainly superphosphates, and they propose with other interested parties to erect a factory for the production of sulphuric acid. With the aid of sulphuric acid, potassium sulphate, which is still in demand by many agriculturists, could be manufactured.

U.S.A. PLANT EXPANSION

At their Deer Park plant in Houston, Texas, the Shell Chemical Corporation proposes spending $2,500,000 on the expansion of facilities for producing methyl ethyl ketone and secondary butyl alcohol, output of which is expected to be increased by 150 per cent. The alcohol is used in lacquers and in the manufacture of compounds for use in ore flotation. Methyl ethyl ketone has many uses in lacquers, lacquer thinners, moulded plastics, artificial leather, aircraft dopes, de-waxing of lubricating oils, and in printing and lithography. Also included in the production expansion plans is a chemical designated "D-D" (not to be confused with DDT) which is a soil fumigant, toxic to soil-borne pests attacking plants, and which is claimed to have resulted in crop increases of from 100 to 300 per cent.

Ground prosphate production in France amounted to 20,000 tons in October, a notable increase over the monthly average of 12,500 tons in 1938. Output of carbonate of soda was 10,500 tons above the pre-war average, while oxygen output increased from 1,850,000 to 3,000,000 cubic metres. Output of ammonia declined to 15,900 tons, against a pre-war monthly average of 18,500 tons; sulphuric acid production was 75,000 tons against the pre-war figure of 106,000 tons, while chloric acid was 2750 tons below the 1938 average.

PARLIAMENTARY TOPICS

Export of Steel Sheets.—In the House of Commons last week Air Commodore Harvey asked the President of the Board of Trade what quantity of steel sheets under 3 mm. in thickness had been exported in each of the last three months to the U.S.S.R., Germany and France, and how many tons of similar steel sheets were in stock awaiting shipment to these countries.

The Parliamentary Secretary informed him that during August to October the only exports to these countries of steel sheets of thickness under ⅛ in., which was just over 3 mm., were six tons to France in August and four tons in September. No information was available of stocks awaiting shipment.

Pre-war Use of Linseed Oil. — The President of the Board of Trade was asked by Mr. Hubbard which industries received an allocation of linseed oil; what tonnage each received; and how this compared with their pre-war usage.

Regarding the first two parts of the question, Sir Stafford Cripps referred him to an answer by the Ministry of Food on November 27 (*see* THE CHEMICAL AGE, December 12, 1946, p. 708). As regards the last part, Sir Stafford said the Census of Production Reports for 1935 showed that the paint, varnish and white lead group of industries used in that year 47,900 tons of linseed oil and the linoleum and leather-cloth industries 33,900 tons. The printing ink industry used 3055 tons of vegetable oils of all kinds.

Increased Price of Linseed Oil.—Explaining why the controlled price of linseed oil in Britain had been raised from £65 to £135 per ton, in answer to Sir Waldron Smithers, the Minister of Food said it was to cover the increased cost of this commodity in the present conditions of extreme shortage.

Glue and Gelatine Exports.—Mr. Erroll asked the President of the Board of Trade the separate quantities of domestically produced glue and gelatine exported monthly since the re-imposition of the Control of Glue (No. 3) Order.

Such figures, however, were not available, according to Mr. Marquand. Exports of animal and fish technical gelatine and glue and size were 95 tons in August, 152 tons in September, and 92 tons in October, he added.

Reduced Lead Stocks.—Every effort was being made to import as much lead as possible, but in present conditions of world shortage he saw no prospect of building up stocks, said Mr. Leonard, replying to Mr. Marples, who asked the Minister of Supply if he were aware that stocks of refined lead had fallen from 121,900 tons at July, 1945, to 19,800 tons at September, 1946.

Shortage of Geologists. — Asked by Mr. Rankin if he were prepared to appoint a commission to undertake a geological survey of Tanganyika, Uganda and Kenya, the Secretary of State for the Colonies declared that he was alive to the need for a much increased effort in the sphere of geological survey in the Colonies generally, including the East African territories. His recently appointed geological adviser was bringing all these questions into immediate review and would advise him on the best means of obtaining speedy results.

"The chief limiting factor," added Mr. Creech Jones, "is the shortage of trained geologists; and I should like to take this opportunity of reiterating my earlier appeal to young men entering upon higher studies to consider the attractions of this important profession in the Colonies."

Requisitioned Industrial Premises. — Of 40,900,000 sq. ft. of industrial floor space still under requisition by Government departments, 28,900,000 would be derequisitioned by the end of the year, the Parliamentary Secretary, Board of Trade, stated in reply to a question from Mr. S. Shephard.

PURIFICATION OF NEW SYNTHETIC ELEMENTS

Speaking before the Rochester (New York) section of the American Chemical Society, in the second annual Harrison Howe lecture, Dr. Glenn T. Seaborg, University of California nuclear chemist, reported that Americium, the synthetic element 95, has been isolated in a pure compound in a large enough quantity to study it on the ultra-microchemical scale. Dr. Seaborg said that details of the chemical properties of the synthetic element have been learned by Dr. B. B. Cunningham, assistant professor of chemistry.

"This work of Cunningham's is a remarkable achievement in that the amounts available here were even smaller than those in the case of neptunium and plutonium," Dr. Seaborg said, and added that "this is the third synthetic element which has been isolated in pure form."

A CHEMIST'S BOOKSHELF

Organic Reactions. Vol. III. Edited by Roger Adams, p. 460. Chapman and Hall, London. $5.

Organic chemists again have cause to be thankful that Roger Adams and his collaborators have produced a third volume of *Organic Reactions*. The contents of this volume deals with nine important synthetic reactions which are: the Friedel-Crafts method for alkylating aromatic compounds, the Willgerodt reaction, preparation of ketenes and ketene dimers, sulphonation of aromatic hydrocarbons, and their halogen derivatives, azlactones, substitution and addition reactions of thiocyanogen, and a chapter each on the Hofmann, Schmidt, and Curtius reactions.

The first chapter on the Friedel-Crafts reaction deals only with the methods by which aromatic hydrocarbons, some phenols and phenol ethers can be alkylated. It does not deal with the production of ketones by using acid chlorides or anhydrides. The greater part of the chapter is occupied by numerous tables which list the various types of substance alkylated and gives such details as the nature of the alkylating agent, the catalyst, and the quantities used together with the solvent, time and temperature of the reaction, names and yields of the products, and a reference to the original papers. Before these tables there are a few general remarks on the reaction in general, such points as the best catalysts for various types of reaction being mentioned, together with the possibility of re-arrangement of the alkyl groups and other limitations. In this chapter, as in all other cases, a selection of experimental directions is given although it would have been an advantage to give another example of the alkylation of a phenol apart from using liquid hydrogen fluoride as a catalyst.

The second chapter is devoted to a series of closely related reactions which are concerned with the conversion of a carbonyl compound into an amide with the same number of carbon atoms. The original method used by Willgerodt has subsequently been modified by Kindler and others, and these modifications are described and in the experimental directions are found examples of both types.

In view of the wide uses of ketenes and the large amount of work published on these compounds recently it is most welcome to find this chapter where directions are given for the preparation of these compounds in the laboratory and where the numerous patents on the subject are listed and reviewed.

The next chapter, that on sulphonation, will have a wide appeal owing to the very general use of this type of reaction. The nature of various sulphonating agents are at first considered together, with a few words on the formation of sulphones as the most common by-products. Then follows a brief description of the results obtained on sulphonating various hydrocarbons from benzene to poly-nuclear compounds such as naphthalene, anthracene, and phenanthrene, and including halogenated benzenes. Incorporated in the selection of experimental procedures are listed various methods for the isolation and identification of sulphonic acids. The tables which follow are divided, as in the first chapter, according to the nature of the compound undergoing sulphonation.

In the chapter on azlactones various methods for their preparation are given together with a discussion of their properties and the reaction which they undergo. Particular attention is paid to the various types of compounds which can be prepared from azlactones.

Chapter 6, on the reactions of thiocyanogen, follows much the same layout as that on sulphonation in that the types of compounds which may be thiocyanated are discussed and the various methods for generating thiocyanogen given. No less than eight examples are given in the section on experimental procedures which is followed by a list of compounds which may be substituted in this manner.

The last three chapters follow the same pattern in that the mechanism of the reactions is discussed together with the scope and limitations involved. There then follows a selection of experimental conditions and procedures together with tabulated lists of the compounds which have been prepared or subjected to the Hofmann, Schmidt or Curtius reactions.

As will be readily appreciated from the outline above there is much in this new volume which will be of the greatest use to all organic chemists particularly those engaged on research who normally have to spend so much time in searching the literature.

G.S.D.

Personal Notes

MR. R. PARK GUILD has been appointed deputy managing director of Salts (Saltaire), Ltd.

MR. R. E. WILLIAMS, a member of the staff of Monsanto Chemicals, Ltd., at Ruabon, has now received from the King the George Medal he won while serving with the R.A.F.

DR. C. F. BAREFORD, M.Sc., Ph.D., who was formerly with the B.T.H. Company and later went to the Admiralty, has been appointed manager and head of the new electronics research laboratory of Mullard Wireless Service Co., Ltd.

DR. B. S. GIDVANI, who, until recently, was director of the London Shellac Research Bureau, has returned from an extensive tour of India and Europe. As from January 1 he will be available at 25 Cheyne Place, London, S.W.3, for consultations on the uses of shellac, etc.

DR. KATHLEEN LONSDALE has been appointed Reader in Crystallography in the Department of Chemistry of University College, London. Her appointment marks the first important step in the creation of a new university centre for the training of crystallographers and crystallographic research workers.

MR. T. T. WALTON, joint managing director of Smith & Walton, Ltd., Haltwhistle, and MR. J. CLARKSON, director of the Strathclyde Paint Co., Ltd., Glasgow, have been elected president and vice-president respectively, of the National Federation of Associated Paint, Colour and Varnish Manufacturers of the United Kingdom for the year 1946-47.

"THE BULLETIN"

In the form of a brightly-edited, informative and entertaining bi-monthly, *The Bulletin* of Johnson, Matthey & Co., Ltd., Hatton Garden, London, E.C.1, provides the necessary link between the 3000 persons connected with this and associated companies. Numbers 1 and 2 have just reached us and, enlarged in size and expanded in contents, show a commendable advance on the modest stencilled sheets with which the idea was started eight years ago and which carried on despite wartime difficulties. If the standard of material presented in these first two numbers is maintained, it should prove of value as well as interest to all concerned—perhaps even to outsiders.

Research on Cast Iron

An Important Discovery

A PROCESS that will involve a new approach to the design of iron castings and influence every branch of the industry was referred to by Dr. Harold Hartley, president of the British Cast Iron Research Association, when speaking at the silver jubilee luncheon of the association in London on December 11.

Dr. Hartley said research on the process was started at the association's research station at Bordesley Hall, Alvechurch, Birmingham, in 1936, after the association had made public a method showing how fine graphite structures could be produced from a titaniferous iron. To-day, in the laboratory, 20-30 ton tensile cast irons can be produced by casting an ordinary hematite pig iron suitably treated.

How scientists have succeeded in casting iron into the mould with a graphite structure of nodular or spherical form was described by Dr. Hartley, who said he regarded as most significant the fact that the new process is applicable to irons most easily castable and least subject to shrinkage in casting. The virtually new material possesses the properties of the present high-duty cast irons and yet remains readily castable and machinable. It will not supplant high-duty irons, but rather will be used as a base for producing high-duty cast irons, the properties of which will no longer be determined by the flake graphite structure.

Another feature of the new material, described by Dr. Hartley, is its uniformity in properties from piece to piece. No bar tested showed any flaw. Strength, detection and shock resistance are doubled or even trebled.

Latest types in their range of mechanical water meters of the rotary semi-positive type for domestic and industrial supplies are described by George Kent, Ltd., Luton and London, in a new publication, No. 906/1946. The various types are fully detailed, with ample illustrations, methods of operation being explained, followed by installation and maintenance notes, data chart and selection guide. An interesting feature of the booklet is a brief survey of the development of the firm's water meters from 1883, in which year the manufacture of water meters was inaugurated, the first stage being an agency for the Meinecke Inferential Meter. A picture of this early model is given, along with pictures of the three succeeding models, including the up-to-date "M" type, which is now extensively used by water authorities and industrial undertakings all over the world, as shown by photographs in the booklet.

Home News Items

The Library of the Chemical Society will be closed from Tuesday, December 24, until Saturday, December 28, inclusive.

Numerical and classified lists of D.T.D. Specifications, with a list of relevant B.S. Specifications cancelled since April, 1930, are now obtainable from H.M. Stationery Office (6d.).

Visits to Germany by British business men desirous of renewing old contacts and exploring possibilities for trade when Germany is allowed to trade again may soon be permitted under a plan reported to be under discussion in Berlin between British Administration officials in conjunction with commercial experts.

A plea for continued co-operation between science and industry was made by Dr. D. T. A. Townend, formerly Livesey Professor of Coal, Gas and Fuel Industries at Leeds University, when he gave the second Brotherton Memorial Lecture to the Society of Chemical Industry in Leeds on December 12. Industry, he said, was competing strongly for our most able scientists and, though great strides had been made through the Department of Scientific and Industrial Research and through some of the universities, there was still a long way to go.

Wholesale prices, as measured by the Board of Trade index number, rose by a further 0.8 per cent in November. This was the largest rise since July, when seasonal changes in price affected the index to a considerable extent. The rise last month was essentially confined to non-ferrous metals and textiles. The increase of 4.5 per cent in the non-ferrous metals group was due to advances in copper and zinc prices, the full effect of which, however, will not be shown in the index till December. Since this time last year, the group as a whole has risen by 37½ per cent.

The prices of refined glycerine will be advanced on January 1, 1947, by £37 10s. per ton, making the new basis prices for B.P. quality £120, and for industrial pale straw £115 per ton, compared with to-day's prices of £82 10s. and £77 10s. The usual additions to these prices for smaller quantities and packages will be continued and the other terms of sale are unchanged. In making this announcement, the United Kingdom Glycerine Producers' Association adds that the new prices are an attempt to approximate to a reasonable level of post-war value for glycerine in relation to the higher values of other commodities.

The number of employees at the new Dunlop factory at Speke, Liverpool, has passed the 5000 mark.

Seeking a bigger allocation of linseed oil, representatives of employers and employees in the Kirkcaldy linoleum industry attended a conference in London this week with the President of the Board of Trade.

Since our report last week of Britain's purchase from the Argentine of 200,000 tons of vegetable oils, including 100,000 tons of linseed oil, it has been suggested that the International Emergency Food Council may allocate to this country the entire consignment of seed oil and cattle cake.

Business communications with Germany, " of a limited character," are now permitted under the terms of a general licence issued by the Board of Trade by arrangement with the Postmaster-General. Arrangements have also been made for the transmission of powers of attorney to the British zone of Germany and the British sector of Berlin through official channels.

To promote, protect and further the status and interests of instrument technology, including design, application, use and maintenance of instruments used for scientific and industrial measurements, the Society of Instrument Technology, Ltd. (425,588) has been registered as a company limited by guarantee without share capital. Management is vested in an executive council, including Mr. D. A. Oliver, Director of Research, B.S.A. group; Mr. W. J. Clark, instrument research manager of I.C.I., Billingham Division; and Mr. R. E. W. Iggledene, works manager, British Rototherm Co., Ltd. The registered office is 80, Bishopsgate, London, E.C.2.

The metals and chemicals sections absorbed nearly 50 per cent of the 93,000 increase during October in the labour force employed in manufacture for the home market, as revealed in employment figures for the month issued by the Ministry of Labour and National Service. The present total working population is shown to be 606,000 more than in mid-1939, this being accounted for by there being 700,000 more women at work, the number having remained stationary in October at 5,806,000, whereas the number of men at work dropped by a further 46,000 to 14,550,000 and is now 106,000 below the 1939 figure. Unemployment between October 14 and November 11 again showed little change.

Overseas News Items

The export price for U.S. copper, f.a.s. New York, has been advanced one cent to 19.50 cents per pound.

Formers in the United States bought fertilisers worth 440,000,000 dollars during 1945, compared with 400,000,000 dollars in 1944 and 215,000,000 dollars in 1939.

The B. F. Goodrich Chemical Co., of Cleveland, Ohio, has entered the biochemical field and will soon be producing a wider range of agricultural, textile, pharmaceutical, and household chemicals.

The French Ministry of National Economy has lifted the price control on gum arabic, insoluble gums, copal, benzoin and other gums.

Holland produces at present about 300 to 325 metric tons of crude oil monthly, derived from twelve producing wells in Drente Province, located chiefly round the village of Schoonebeek. Current output covers 8 per cent of the country's total requirements.

Linseed exports from Uruguay are likely to be controlled. A Bill recently submitted to the Senate proposes an export duty of 10 per cent on the difference between the current quotation and the three-yearly average price for the years 1937-39 inclusive.

The Shell Chemical Corporation intends to manufacture synthetic glycerine on a commercial scale at its Houston, Texas, plant, early in 1948. Production in the new plant, the erection of which costs about 7,000,000 dollars, will be based on propylene chlorine and caustic soda.

The Peruvian Minister of Public Health has issued a Supreme Resolution which lays it down that national laboratories engaged in the manufacture of insecticides and parasiticides are to be under the control of qualified chemists holding a diploma of a Peruvian university.

Algeria has a small chemical and fertiliser industry. The largest firm, the Sapce (Société Algérienne de Produits Chimiques et d'Engrais) has three plants, producing mainly sulphuric acid, superphosphates, copper and iron sulphates, carbon disulphide and oxygen, as well as various secondary types of fertilisers. Capacity for the production of sulphuric acid is about 100,000 tons per annum, but far less has been produced. This information is included in a review of economic conditions in Algeria published by the Canadian *Commercial Intelligence Journal*.

Penicillin is to be manufactured by a company recently established at Joettingen in the British zone of Germany.

For combating a locust plague, the Greek Ministry of Agriculture is seeking to purchase from the United States 100 tons of Gammexane.

Spain and Norway are to export 115,000 tons and 30,000 tons of pyrites to the British occupation zone of Germany. These shipments should make it possible to maintain production of sulphuric acid in that area.

Rich deposits of uranium in China are now controlled by Russia, according to unconfirmed reports. The deposits, it is claimed, were originally discovered by the Japanese about 140 miles from Port Arthur, which is open to Russian vessels.

Important deposits of bentonite on the east coast of New Zealand are being investigated by the New Zealand Geological Survey Department and hundreds of tons of the mineral have already been recovered, according to reports from Wellington.

Canada's imports of chemicals and allied products in the eight months' period of January to August, 1946, increased 18 per cent in value over those in the same period of 1945. The imports amounted to $61,548,000 for the 1946 period, and $52,042,000 for 1945.

The Japanese Ministry of Welfare, in co-operation with the Ministry of Education, is to supervise research, production and distribution of penicillin, the large-scale production of which is actively planned in the country. A U.S. expert has arrived to teach the Japanese mass-production methods.

Czechoslovakia is now tackling the task of implementing the Two-Year Plan which became law in October. Under this, hard coal production is to be increased in 1948 by 17 per cent over present figures; brown coal production is to be increased by 21 per cent; and pig-iron by 36 per cent.

German and Austrian scientists have saved the United States more than 750,000,000 dollars in basic research on rockets alone and advanced American research in several fields from two to ten years, according to a War Department estimate. Foreign technicians working in the States already number 270 and it is hoped to increase the total to 1000. Their work covers, among other fields, electronics, supersonics, synthetics, and phases of applied physics and chemistry.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

AFFINED BASIC CHEMICALS, LTD., London, W. (M., 21/12/46.) November 20, charge, to Westminster Bank, Ltd., securing all moneys due or to become due to the Bank; charged on Empire Works, Newland Meadows, High Wycombe, including fixtures. *Nil. October 16, 1945.

Satisfactions

BRITISH BENZOL & COAL DISTILLATION, LTD., Bedwas. (M.S., 21/12/46.) Satisfaction November 27 of Trust Deed registered September 21, 1937.

Company News

For the year ending May 15 next, the **Distillers Co., Ltd.**, is paying an interim ordinary dividend of 1s. 6d. per £1 of stock (equal to 7½ per cent actual).

With net profit totalling £13,251, as compared with £13,059 for the previous year, **Crystalate Ltd.** is again paying an ordinary dividend of 6 per cent for the year ended September 30.

Dividend of 8 per cent on the larger capital for the year ended June 30 is being paid by **Midland Tar Distillers, Ltd.**, who paid 7 per cent the previous year. Net profit of £49,599 compares with £39,381.

Genatosan, Ltd., reports net profit of £55,242 for the year ended June 30, as against £45,516 for the previous year. The interim ordinary dividend of 10 per cent and final of 40 per cent compare with a total of 30 per cent for the previous year.

An ordinary dividend of 5 per cent, as against 3½ per cent for the previous year, is being paid by **English Clays Lovering Pochin & Co., Ltd.**, for the year ended September 30. Net profit of £227,875, compared with £134,379.

As from January 1, all Dunlop goods sold in Scotland, except clothing and Semtex, will be handled by a separate Scottish company, the **Dunlop Rubber Co., (Scotland) Ltd.** Its capital is £50,000 in £1 shares and the directors are Mr. G. E. Beharrell, Dunlop managing director, who will be chairman; Mr. H. L. Kenward, Dunlop director of distribution; Mr. J. H. Lord, Dunlop financial comptroller; and Mr. William Sinclair, Dunlop regional manager for Scotland.

New Companies Registered

W. M. Gardner & Co., Ltd. (425,115).—Private company. Capital £1000 in 1000 shares of £1 each. Research and analytical chemists, etc. Subscribers: L. Stiles; F. Barnsdale. Registered office: 68, Kilburn Park Road, London, N.W.6.

Nuodex International (U.K.) Ltd. (425,518).—Private company. Capital £1000 in £1 shares. Industrial chemists, etc. Directors: E. Bader; A. Cooper; E. Fairhead. Registered office: 66, Victoria Street, London, S.W.1.

N. Redmond & Co., Ltd. (424,749).—Private company. Capital £100 in 100 shares of £1 each. Consulting, chemical and industrial engineers, etc. Directors: N. Redmond, Mrs. K. Redmond. Registered office: 41, Store Street, Manchester, 1.

Nelson MacNeill & Co., Ltd. (424,660).—Private company. Capital £1000 in 950 6 per cent non-cumulative participating preference shares of £1 and 1000 1s. ordinary shares. Analytical and consulting chemists, etc. Subscribers: G. Hughes; A. James. Registered office: 71, Moorgate, London, E.C.2.

Chemical and Allied Stocks and Shares

STOCK markets are closing the year on a firm note, apart from British Funds, which moved fractionally lower following moderate selling. Home rails showed firmness earlier in the week on hopes that the Transport Bill debate might induce the Government to amend the "compensation" terms. There was good demand for industrial shares, partly on benefits that should be derived by a large number of companies from the abolition of E.P.T.

Chemicals and textiles were prominent among securities favoured on export trade news, buyers appearing to give main attention to shares of companies in industries outside the threat of nationalisation. Iron and steels have been favoured on E.P.T. considerations, as have shares of paint manufacturers, although the latter also remained under the influence of the Lewis Berger dividend increase and the British purchase of linseed oil from the Argentine.

Imperial Chemical rose to 45s. 3d., B. Laporte to 103s., Burt Boulton showed firmness at 27s. on the higher profits disclosed by the full results, while Fisons were

dealt in up to 62s. 6d., and Greeff-Chemicals Holdings 5s. ordinary were 13s. 6d. British Drug Houses at 61s. 3d. were again bought as the company should be a substantial beneficiary from the abolition of E.P.T. Borax Consolidated deferred displayed firmness at 48s. 3d., and British Aluminium strengthened to 46s. British Match have been firm at 54s., and Lever & Unilever were 52s. 6d. Imperial Smelting further improved to 22s. and, following the meeting, Tube Investments were higher at £6 13/16, while at £10¾ International Combustion again reflected higher dividend hopes and share "splitting" talk.

Textiles were helped by benefits likely to be derived from the higher dollar value of exports. Coates were prominent with an advance to 70s., English Sewing Cotton were 37s. 6d., Bradford Dyers 26s. 6d., Bleachers 14s. 7½d., and Courtaulds 54s. 3d. In the paint section, Lewis Berger moved to the new high level of £8, International Paint rose to £7 1/16, and Indestructible Paint to £6. Pinchin Johnson were 51s. 9d., and Goodlass Wall 32s. 10½d. In other directons, Wall Paper Manufacturers rose to 49s. before easing to 47s. 6d.

The units of the Distillers Co. eased to 139s. 6d. on the unchanged interim dividend, while United Molasses at 55s. 3d. failed to hold best levels; but elsewhere, British Plaster Board further strenghened to 34s. 3d., and British Oxygen have been firm at 101s. 10½d. Birmid Industries were 99s. 4½d. on the full results and forthcoming capital increase. Firmness was maintained in British Glues 4s. ordinary at 17s. 3d. with the participating preference 48s. 6d. In other directions, Blythe Colour 4s. shares showed dealings up to the higher level of 50s., while there was activity up to 57s. 4½d. in Morgan Crucible "A" ordinary. A weak feature was provided by a sharp decline of up to seven points in German Potash Bonds, which were sold on doubts whether they will receive priority in reparations payments.

Among iron and steels, Guest Keen firmed up to 46s. 6d., Dorman Long were 28s. with the preferred ordinary good at 50s. Stewarts & Lloyds were 55s., Whitehead Iron 99s. 6d., while elsewhere, Barrow Hæmatite showed a fresh rise to 41s. 6d. South Durham Steel moved up to 27s. 3d., and Ruston & Hornsby to 66s. Babcock & Wilcox were good at 70s. 6d.

Boots Drug strengthened to 64s., Griffiths Hughes rose to 63s. 3d., Sangers were 34s., and Timothy Whites 49s. 6d. Oil shares have been uncertain. Anglo-Iranian rallied to £5 following the latest news from Persia, but were later 99s. 4½d. Apex (Trinidad) and Anglo-Ecuadorian Oilfields at 39s. and 38s. 6d. respectively showed firmness on the higher distributions, although prices eased subsequently, Shell and Burmah Oil also losing a little ground.

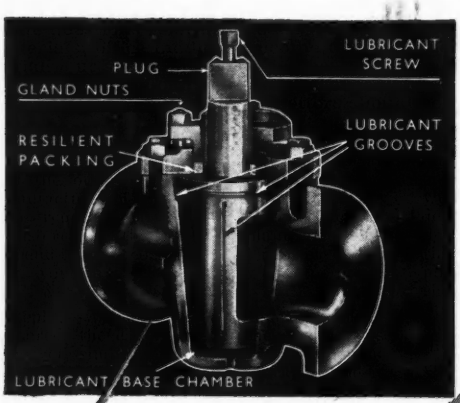
British Chemical Prices

Market Reports

A STEADY movement of supplies in the London general chemicals market has been reported during the past week, with new business increasing in volume where the supply positions permit. Actual price changes have been few, but the undertone is strong throughout and higher quotations in the New Year would not be unexpected. As reported last week the controlled prices for acetic acid and acetone are likely to be revised in the near future, and an advance in the price of refined glycerine as from January 1 has already been notified. An increase in the permitted price of sulphuric acid of strengths of 155° Tw. and below has been authorised by the Board of Trade and came into force on December 9, 1946. The demand for export is fully maintained and inquiries cover a wide range of industrial chemicals and pharmaceutical products. In the coal-tar products market chief attention is being given to contract replacement. Little change is expected in quoted rates and no immediate improvement in the supply position is looked for.

MANCHESTER.—In spite of the approach of year-end influences, including stocktaking, there has been little sign as yet of any easing of activity on the Manchester market for light and heavy chemicals. Inquiry during the past week for the general run of alkali products, as well as other leading heavies, has been on steady lines from a wide range of using industries, and new business is being placed freely. Buying interest on export account has also been prominent. Actual price changes have been few apart from those announced for refined glycerine and certain strengths of sulphuric acid, but the undertone generally is undoubtedly very firm. Activity in most sections of the tar products market so far as the movement into consumption is concerned has continued in evidence.

GLASGOW.—An exceptionally busy week has been experienced in the Scottish heavy chemical market owing to an unprecedented demand for chemical raw materials of all kinds, presumably before price changes take effect in 1947. The heavy demand is also reflected in contracts which are up for renewal, and all indications are that 1947 will be at least equally busy. The export market showed little change, and considerable business was secured, including such chemicals as magnesium, sulphate, zinc chloride; ground limestone, salt, saltpetre, sulphur, nitric acid, caustic soda, soda crystals, and dyestuffs. A number of products showed marked increases in price, and generally markets remained very firm.



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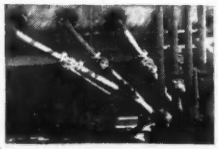

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Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted may be obtained from the Patent Office, Southampton Buildings, London, W.C.2., at 1s. each. Numbers given under "Applications for Patents" are for reference in all correspondence up to acceptance of the complete specification

Applications for Patents

Recovery of alloying elements.—C. Stokes, and D. Wright. 33524.

Non-detonating compositions.—J. Taylor, A. C. Hutchison, and I.C.I., Ltd. 33234.

Gaseous discharge tubes.—Telefonaktiebolaget L. M. Ericsson. 33513.

Anthridine compounds.—Wellcome Foundation, Ltd., F. C. Copp, and L. P. Walls. 33072.

Vaporisation of crude oil, etc.—H. Wright. 33101.

Thermal power plants.—A.G. für Technische Studien. 34258.

Treating wood scour water.—P. S. Ailam. (Fields Point Manufacturing Corporation.) 34596.

Heat treatment of magnesium base alloys. —Aluminum Co. of America. 34676.

Biguanides.—American Cyanamid Co. 34392.

Aromatic amines.—J. C. Arnold. (Standard Oil Development Co.) 34317.

Chemical reaction process.—J. C. Arnold (Standard Oil Development Co.) 34318.

Alumina hydeosols.—J. C. Arnold. (Standard Oil Development Co.) 34963.

Treatment of hydrocarbon.—D. Balachowsky. 34369.

Ethylene derivatives.—British Schering Research Laboratories, Ltd., J. S. H. Davies, and W. Tebuch. 34463.

Polysiloxane resins.—British Thomson-Houston Co., Ltd. 24540-34541.

Binding agents.—Ciba, Ltd. 34249-50.

Hydrophenthrene derivatives.—Ciba, Ltd. 34887-90.

Dyestuffs.—S. Coffey, D. A. W. Fairweather, D. E. Hathway, and I.C.I., Ltd. 34643, 34886.

Dyestuffs.—S. Coffey, D. A. W. Fairweather, F. H. Slinger, and I.C.I., Ltd. 34644, 34885.

Dyestuffs.—S. Coffey, D. A. W. Fairweather, D. E. Hathway, F. H. Slinger, and I.C.I., Ltd. 34642.

Refining acetone.—Commercial Solvents (Great Britain), Ltd., T. Benfield, and H. Holdsworth. 34272.

Recovery of acetone.—Commercial Solvents (Great Britain), Ltd., H. N. Darlington, and H. Holdsworth. 34874.

Surface coating.—Continental Can Co., Inc. 34275.

Purification of acetic anhydride.—Courtaulds, Ltd., and J. G. Spencer. 34260.

Phenolic resins.—Dunlop Rubber Co., Ltd., and M. Goldstaub. 34192.

Rubber derivatives.—Dunlop Rubber Co., Ltd., F. A. Jones, and G. A. Truesdale. 34597.

Metal heating furnaces.—E. S. Elliott, and H. H. Brookes. 34207.

Fuel burners.—L. S. E. Ellis. (Robertshaw Thermostat Co.) 34268.

Aroxy silanes.—H. G. Emblem, E. O. Powell, C. Shaw, and W. E. Smith. 34305.

Dispersion of rubber latex.—Firestone Tyre & Rubber Co. 34231.

Extracting oils from solids.—J. Fretwell, and M. J. Wildgoose. 34706.

Complete Specifications Open to Public Inspection

Chemical process.—Merck & Co., Inc. May 16, 1945. 13242-3/46.

Paint compositions.—Metals Disintegrating Co., Inc. May 19, 1945. 8760/46.

Method of and apparatus for effecting circulation of a liquid for heating or other purposes.—H. G. Montgomery. May 17, 1945. 14852/46.

Manufacturing mouldings of synthetic resin material suitable for high-tension insulation. N.V. Philips Gloeilampenfabrieken. Jan. 22, 1943. 30967/46.

Manufacturing mouldings from a phenol-formaldehyde artificial resin moulding material capable of being hardened and containing wood-flour as a filling material. —N.V. Philips Gloeilampenfabrieken. Jan. 23, 1943. 30969/46.

Manufacture of stable cysteine preparations.—Roche Products, Ltd. May 17, 1945. 28751/46.

Synthetic gem composition.—D. Rosenthal. May 19, 1945. 6770/46.

Process for the separation of isomeric substituted quinoline carboxylic acids and esters thereof.—Soc. des Usines Chimiques Rhône-Poulenc. May 17, 1945. 11194/46.

Production of dinitroethyleneurea.—Stein, Hall & Co., Inc. Feb. 25, 1944 499/45.

Method of bleaching alginic acid.—E. Sundve. April 19, 1945. 32096/46.

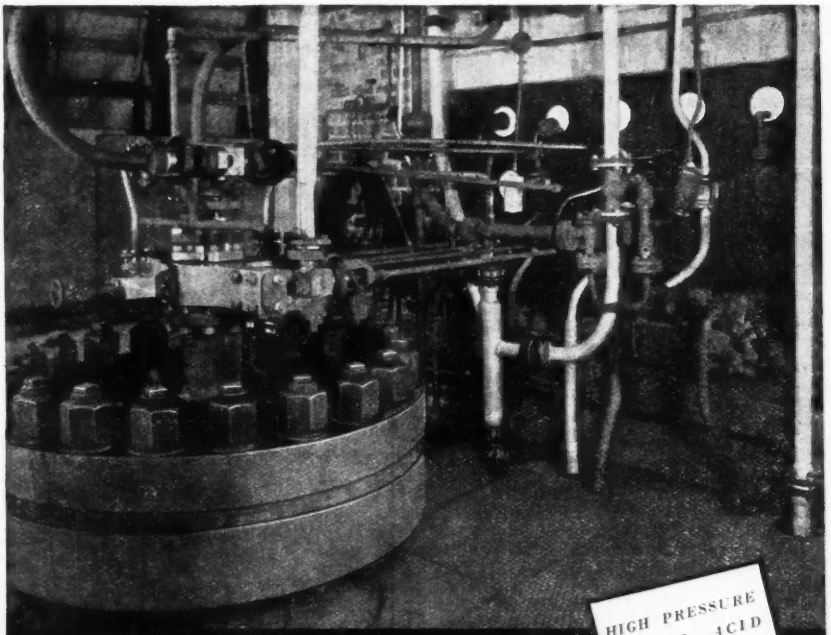
Producing a thermoplastic transfer sheet and transfer coating therewith.—Sylvania Industrial Corporation. May 18, 1945. 11766/46.

Process of coating, article for use therein, and the products produced thereby.—Sylvania Industrial Corporation. May 18, 1945. 13616/46.

Process of coating and article for use therein.—Sylvania Industrial Corporation. May 18, 1945. 14934/46.

Cellulose ethers and process for producing the same.—Sylvania Industrial Corporation. May 19, 1945. 14935/46.

Process of transfer coating and transfer sheets for use therein.—Sylvania Industrial Corporation. May 18, 1945. 14936/46.



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Production of relatively volatile metals by reduction of their ores in an electric furnace.—Union Miniere de Haut Katanga. May 17, 1945. 16494/46.

Adhesive compositions.—United States Rubber Co. Aug. 12, 1943. 14245/44.

Manufacturing aqueous solutions of alkyloxy- or alkenyloxy-2 nitro-5 anilines.—A. P. Weber. May 15, 1945. 2413/46.

Metal alloys.—Westinghouse Electric International Co. May 16, 1945. 14037/46.

Complete Specifications Accepted

Process for the production of polymers.—P. Davies, D. K. Peacock, J. E. Fearey, and I.C.I., Ltd. July 28, 1944. 582,266.

Ceramic abrasive or refractory material.—E.I. Du Pont de Nemours & Co. March 21, 1942. 582,091.

Laminated glass sheets.—E.I. Du Pont de Nemours & Co. Aug. 13, 1941. 582,087.

Manufacture and use of insecticidal compositions.—Geigy Colour Co., Ltd., and I. E. Balaban. Dec. 18, 1943. 582,205.

Process for the manufacture of α.γ-dyhydroxy-β-β-dimethyl-butyric-acid-(3¹-hydroxypropyl)amides.—F. Hoffman-La Roche & Co., A.G. June 14, 1944. 582,156.

Interpolymers of ethylene and organic vinyl esters.—I.C.I., Ltd. June 6, 1942. 582,093.

Process for the polymerisation of esters of acrylic acid and derivatives thereof.—I.C.I., Ltd. Aug. 26, 1943. 582,167.

Production of chlorinated paraxylene derivatives.—I.C.I., Ltd. June 18, 1943. 582,258.

Manufacture of moulding powders and moulded articles therefrom.—Leicester, Lovell & Co., Ltd., and H. A. Collinson. Feb. 1, 1944. 582,247.

Cracking hydrocarbon oils.—Lummus Co. Dec. 10, 1941. 582,175.

Product and process for manufacturing rubber.—Permanente Metals Corporation. March 20, 1944. 582,268.

Vapour phase isomerisation of hydrocarbons.—Shell Development Co. June 6, 1942. 582,138.

Detection and quantitative determination of carbon monoxide in air or other gases at such temperatures as occur in the atmosphere and reagents therefor.—J. D. Main-Smith, and G. A. Earwicker. July 12, 1943. 582,184.

Manufacture of derivatives of sulphonated amines.—Soc. of Chemical Industry in Basle. Dec. 24, 1941. 582,092.

Process for improving the properties of textiles dyed with vat dyestuffs.—Soc. of Chemical Industry in Basle. Jan. 6, 1943. 582,143.

Manufacture of 6-(para-aminobenzene-sulphonamido)-2 : 4 - dimethylpyrimidine.—Soc. of Chemical Industry in Basle. Nov. 4, 1943. 582,149.

Process and apparatus for the polymerisation of olefinic materials.—Standard Oil Development Co. May 27, 1942. 582,137.

Water dispersible casein urea formaldehyde composition and its preparation.—W. Teape & Co. (1919), Ltd., H. F. Rance, and G. F. Glover. Aug. 10, 1944. 582,235.

Water dispersible urea-formaldehyde composition and its preparation.—W. Teape & Co. (1919), Ltd., H. F. Rance, G. F. Glover, and E. J. Pritchard. Jan. 5, 1945. 582,157.

Process for carrying out condensation reactions of substances containing reactive methylene or methine groups.—C. Weizmann. March 2, 1944. 582,191.

Quinoline substituted dihydropyridines.—Wellcome Foundation, Ltd. May 15, 1941. 582,254.

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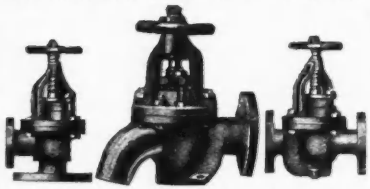

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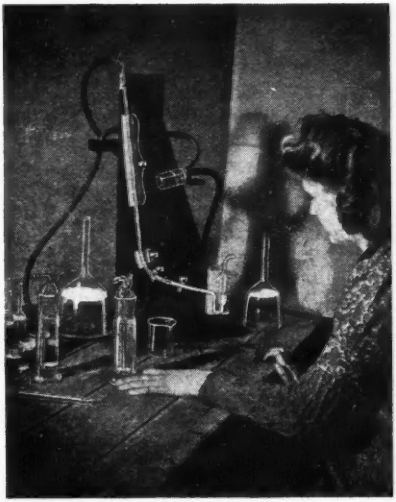

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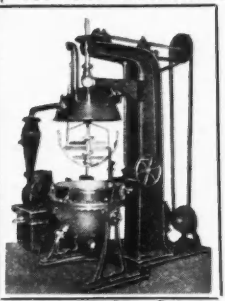

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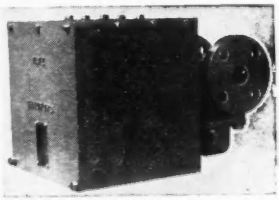

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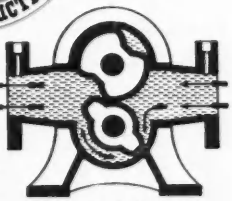

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